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Benefit/Cost Variables and Comparative Recreation Use Patterns of Wilderness and Non-Wilderness Areas

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BENEFIT/COST VARIABLES AND COMPARATIVE RECREATION USE PATTERNS OF WILDERNESS AND NON-WILDERNESS AREAS

by

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Kim S. Christy

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ABSTRACT

Benefit/Cost Variables and Comparative Recreation Use Patterns of Wilderness and Non-Wilderness Areas

by

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Utah State University, 1988

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This paper examines formal wilderness designation and is presented in two parts. The first section offers a general classification and comprehensive review of the benefit and cost variables associated with wilderness designation and management. The second section investigates recreation use, which society has historically perceived to be the highest valued element in the network of wilderness benefits.

Variables associated with the benefits of wilderness designation are presented under three major categories: 1) naturalness preservation, 2) solitude or primitive and unconfined types of recreation, and 3) special features of scientific, educational, scenic, or historic value.

Costs attributed to wilderness designation are presented under two major categories: 1) administration/general management costs and 2) opportunity costs.

The second section of this thesis establishes growth rate comparisons of wilderness and non-wilderness recreation use on United

States Forest Service lands in Utah, the Intermountain Region, and the overall national Forest Service system from 1967 to 1986. The High Uintas Wilderness area was also analyzed for its use over the same twenty-year period. Data used to measure recreational use at these levels was obtained from United States Forest Service Recreation Information Management records and are measured in recreational visitor days. Growth rate comparisons are measured with respect to recreation use in general terms as well as on a per acre basis at all levels examined.

Because of general trend discrepancies in recreation use over the twenty-year study period, growth rate estimates of recreation use at all levels are also measured with respect to two separate time periods--1967 to 1976 and 1977 to 1986. This analysis shows that non-wilderness/primitive recreation use per acre increased during the last decade at all levels examined, whereas wilderness/primitive recreation use per acre showed marked declines during the same period.

Growth rate estimates established on a per acre basis provide a general indication of the marginal value of wilderness and non-wilderness recreation use. This thesis shows that, with respect to recreation use, marginal utility has diminished in designated wilderness since 1977. In contrast, this research also infers that the marginal value for non-wilderness recreation use has increased. These findings suggest that, from a recreation perspective, adding wilderness areas to the National Wilderness Predervation System is unwarranted.

(119 pages)

CHAPTER I

INTRODUCTION

One of the most controversial public policy issues in the western United States today is wilderness designation. Although legislation allowing for its creation has been in place since 1964, expanding levels of emotionalism and varying economic interpretations of its impacts have generated a network of chaos for politicians and public land managers.

When Congress designates a portion of federal land as wilderness, it presumes that the social benefits will outweigh all costs. Yet decision makers have often been frustrated with inadequate measurement of benefits and how they compare with costs. Methodological limitations associated with measuring benefit/cost relationships in this area have forced decision makers to depend heavily on subjective information and evaluations in formulating their decisions.

The relatively strong demand now in place for wilderness, as well as opposition to it, warrants closer examination of its socioeconomic impacts. Although the issue has not been totally ignored by researchers, it appears that over the last decade studies documenting benefits derived from formal wilderness designation far outnumber studies documenting costs.

Providing primitive forms of recreation has historically served as a major justification for adding acreage to the national wilderness preservation system. For instance, in a 1980 survey of Colorado residents, Gillman found Colorado wilderness recreation use valued at $21.4 million as compared to a total of $15.66 million in preservation

benefits. In other words, he found recreation use benefits valued 37% greater than preservation benefits. This study did not measure the values attributed to recreation use and preservation benefits derived from individuals outside of the state, however. Had it done so, the values would have been greater.

Pope and Jones conducted a similar survey of Utah residents in their attempt to measure non-market valuation of wilderness designation in Utah. Their findings established annual values of wilderness preservation ranging between $10 and $38 million. However, their estimates did not report what portion of Utah's wilderness value was specifically attributed to recreation use.

Objectives

The initial intent of this thesis was 1) to identify and compile a general classification of the variables associated with the benefits and costs of wilderness designation and 2) to isolate a particular wilderness area and offer a detailed economic analysis of the measurable costs and benefits associated with its designation and management. The researcher's ability to adequately meet objective #2, however, was constrained by a lack of necessary information. Due to the lack of information, and because of the suggested significance of recreation use of designated wilderness areas on United States Forest Service (USFS) lands, the second objective was redefined.

Revised objective #2 is to specifically analyze various segments of USFS recreational use levels over a twenty-year period (1967-1986). Relative comparisons of wilderness and non-wilderness recreation are made on USFS lands in Utah, the Intermountain Region (see figure 1),

Figure 1. Intermountain Region (Region 4), US Forest Service

which is commonly referred to as Region 4, and the overall national Forest Service system. For further comparison, the High Uintas Wilderness area, which has traditionally served as one of Utah's major recreation areas, is also analyzed for its use over the same twenty-year period.

The analysis and discussion stemming from objective #1 and revised objective #2 is intended to provide a guideline for policy makers and managers considering changes in public land classification relating to wilderness.

General Procedures

Objective #1, identifying and compiling a general classification of the variables associated with the benefits and costs of wilderness designation, is met by performing a detailed literature review. Driver et al. offered a comprehensive review of the benefits attributed to wilderness. However, the literature to date suggests that no complete single classification exists which also includes costs.

Objective #2, the empirical portion of this thesis, is met by using ordinary least squares regression techniques to establish percent compounded rates of growth of wilderness and non-wilderness recreation use from 1967 to 1986 on national forest lands mentioned above.

Study Outline

The general outline of this thesis proceeds from a discussion of benefit/cost relationships associated with wilderness designation to detailed examination of historic recreation use patterns of USFS wilderness and non-wilderness areas, and then on to application.

Chapter II offers a taxonomic scheme and discussion of benefits attributed to wilderness designation. In contrast, Chapter III presents a taxonomic scheme and discussion of cost variables associated with wilderness. The empirical portion of this thesis begins with Chapter IV where application of econometric models and tests of hypotheses are presented relative to wilderness and non-wilderness recreation use patterns on USFS lands in Utah, Region 4, and the nation as a whole. Chapter V provides the results and a discussion of statistical application of the methods presented in Chapter IV. Chapter VI completes this thesis by presenting a summary and conclusion, along with some suggestions for further research in wilderness economics.

CHAPTER II

BENEFITS ATTRIBUTED TO WILDERNESS DESIGNATION AND MANAGEMENT

As indicated in Chapter I, one of the primary objectives of this thesis was to formulate general categories and compile a listing of specific variables describing the benefits and costs of wilderness designation. Although numerous variables have been identified either by management agencies, researchers, special interest groups, or concerned citizens, the literature to date appears to provide no complete single classification. Admittedly, however, work has been done from the standpoint of benefits. Driver et al., for instance, recognized the need for more objective information on wilderness benefits and thereby presented a detailed taxonomic scheme classifying benefits under personal, social, and intrinsic categories. Their findings were based "on introspective appraisals of benefits inferred from human preference studies" (p. ii).

Perhaps what makes wilderness designation so controversial is the underlying perception of its own character. Nash's well-known book entitled Wilderness and the American Mind portrays wilderness as a state of mind. Rather than merely possessing certain objects in a natural setting, wilderness is a resource that offers feelings about those objects. Driver et al. recognized wilderness benefits in this context. Kaplan observed that the themes of simplicity, wholeness, and a sensitivity to nature offered by wilderness "have a bearing on self-discovery" (p. 287). She concluded that it "may offer an extreme,

and hence unusually clear, perspective on some vital facets of effective human functioning" (p. 287).

The subjectivity associated with identifying benefits attributed to wilderness designation clearly presents a challenge. Nonetheless, the Wilderness Act of 1964 recognizes benefits in the general sense of providing enjoyment for the American people through protection and preservation of natural conditions and wilderness character of these areas. Section 2(c) of this act identifies these factors.

The BLM's mandate from congress to identify wilderness areas came through the Federal Land Policy and Management Act of 1976 (FLPMA). Collectively, it refines the factors identified in the act of 1964 and refers to them as "wilderness characteristics." These characteristics fall into three general, and probably more understandable, categories: 1) naturalness, 2) outstanding opportunities for solitude or primitive and unconfined type of recreation, and 3) special features. The following descriptions and management objectives of each of these categories are taken from U.S. Dept. of Interior, BLM:

> **Naturalness.** A natural distribution of native species of wildlife, fish, and plants will be fostered by ensuring that natural ecosystems and ecological processes continue to function naturally with minimal human influence.
>
> **Solitude or Primitive and Unconfined Type of Recreation.** Solitude is defined as 1) the state of being alone or remote from habitations; isolation; 2) a lonely, unfrequented, or secluded place. The emphasis is on the opportunities a person has to avoid the sights, sounds, and evidence of other people within a particular area. Primitive and unconfined types of recreation are defined as those activities that provide dispersed, undeveloped recreation which do not require facilities or motorized equipment. In most cases, opportunities for solitude and recreation are dependent on naturalness.
>
> **Special features.** Ecological, geological, and other features of scientific, educational, scenic, or

historical value will be maintained. (pp. 9-10)

Since these three general categories have been identified and accepted by national lawmakers, it is believed that this classification of variables with respect to benefits is appropriate for this study.

Contrary to Driver et al.'s review, this effort will classify specific variables under these categories and will rest on the assumption that benefits derived through wilderness designation are considered unique to designated wilderness areas. Therefore, some of the benefits included in Driver et al.'s review will not be considered here. For example, benefits received by livestock permittees through grazing privileges will not be recognized as benefits because these privileges would generally be made available even if areas grazed were not designated as wilderness. (The argument has actually been made that the benefit stream of domestic livestock grazing in wilderness areas could be negatively affected relative to non-wilderness (Utah Farm Bureau Federation)).

Table 1 presents an outline of the variables associated with wilderness benefits subject to the aforementioned assumption.

Naturalness Protection and Preservation of Natural Conditions

The benefits derived or classified under the general category of naturalness stem from protectionism and preservation of natural conditions as indicated in the Wilderness Act of 1964. In the context of wilderness benefits, Walsh et al. defined preservation values as:

> Preservation values are nonmarket public goods, as their consumption is both nonrival and nonexclusive, that is, beneficiaries of environmental protection can be added without diminishing the value of the resource

Table 1. Taxonomy of Wilderness Benefits

I. Naturalness (Protection and preservation of natural conditions)
   A. Option, Existence, and Bequest Values
      1. Symbolism and Nurturance
      2. Water Quality
      3. Air Quality and Visibility
      4. Inherent/Intrinsic (benefits to non-human organisms)

II. Solitude or Primitive Unconfined Type of Recreation
   A. Personal Development
      1. Mental and Moral Restoration
      2. Skill Development
   B. Therapeutic/Healing
   C. Self-Sufficiency
   D. Social Identity (development/maintenance of desired social relations with family members and friends)
   E. Esthetic/Creativity

III. Special Features
   A. Ecological
      1. Representative Ecosystems
      2. Species Diversity
   B. Geological (unique land forms)
   C. Scientific (research)
   D. Educational
   E. Scenic
   F. Historical

> to others. Consumer surplus of recreation use is undiminished by changes in the preservation value of the general public. (p. 15)

According to Gillman, three values combine to determine preservation benefits: option value, existence value, and bequest value.

Option Value

Option value is recognized as the willingness to pay something for an opportunity to consume a commodity in the future (Weisbrod). It has been a concept of considerable debate among researchers over the last twenty years. Much of this debate has centered on whether or not it should be considered separate from or a portion of consumer surplus, which is that amount of money consumers would be willing to pay for the right to continue to buy something at its current price (Long). For a discussion on various views of option value see Long, Byerlee, Cicchetti and Freeman, Schmalensee, Henry, Arrow and Fisher, Irland (1979), Gillman, Freeman, and Wilman.

Weisbrod first formally introduced option value and contended that it will exist when two conditions hold: 1) the condition of uncertainty of supply or infrequency of use is present and 2) the costs of resuming production of a commodity are prohibitively high once the commodity in question is no longer made available. It could be conceptually argued that development occuring in a potential wilderness area would alter wilderness characteristics and in effect stop the production of various wilderness commodities (Gillman). Gillman argues that ". . . a decision favoring preservation is not necessarily irreversible in terms of development. A development decision, however, is" (p. 61).

According to Gillman, much of the confusion in the debate over option value stems from inconsistencies in the interpretation and

application of Weisbrod's conditions of uncertainty of future use. He argues that option value is additive to consumer surplus.

Wilman found that it is not possible to make simple generalizations about the sign of option value and showed that the sign can be either positive or negative. She concluded that if changes of a small increase in the probability of supply occur and the original probability is close to zero, option value is likely to be negative. However, when changes associated with a small increase in the probability of supply occur and the original probability is close to one, then option value is likely to be positive.

In summary, the literature to date suggests that under conditions of uncertainty of demand and/or supply, option value becomes significant in valuing natural environments and is recognized as such in this review.

Existence Value

Existence value is defined by Gillman as ". . . the amount an individual would pay to preserve a wilderness area just for the satisfaction of knowing that it is there" (p. 62). The subtle difference between option value and existence value is that the latter values preservation regardless of consumption.

Krutilla first introduced the concept that individuals may have existence values for natural environments. He explains the concept in this way:

> There are many persons who obtain satisfaction from mere knowledge that part of wilderness North America remains even though they would be appalled at the prospect of being exposed to it. Subscriptions to the World Wildlife Fund are of the same character. The funds are employed predominanatly in an effort to save exotic species in remote areas of the world

> which few subscribers to the Fund ever hope to see. An option demand may exist therefore not only among persons currently and prospectively active in the market for the object of the demand, but among others who place a value on the mere existence of biological and/or geomorphological variety and its widespread distribution. (p. 781)

Cicchetti and Freeman pointed out that like option value, existence value is not an important measurement unless supply is uncertain. The same holds true for bequest value.

Bequest Value

Walsh et al. defined wilderness bequest values as the willingness to pay for the satisfaction derived from endowing future generations with wilderness resources. An existing generation is capable of contributing such resources as long as they are preserved. Clearly, bequest values of an area become more significant if its preservation is threatened. Krutilla also defended this concept and treated it as a separate category from option and existence value (as this review has done).

Walsh et al. admit "that the distinction between option and existence value is somewhat clouded by bequest values. . ." but ". . . that however combined, the preservation value concept can include option, existence, and bequest values" (p. 14).

Symbolism and Nurturance Benefits

Under the umbrella of option, existence, and bequest values of designated wilderness areas comes benefits brought on by symbolism and nurturance opportunity--two related variables that attribute values to preservation. They represent perceived benefits derived from protection of unmodified natural environments with few traces of man and are

consistent with values and beliefs of individuals who may or may not choose to visit wilderness areas. Driver et al. addressed the "specific dimensions" of symbolic benefits and indicated that they "include the benefits individuals derive just from knowing that society collectively is being a good steward through conservation and preservation actions" (p. 26). They also recognized that the context of how one perceives such benefits is an important consideration.

One must be careful in acknowledging benefit attributes of wilderness designation not only with respect to symbolism, but also in many of the characteristics as outlined in table 1. For example, resource stewardship has been considered as a sub-listing under symbolism. In the context of the symbolic attributes it represents, there is indeed a unique opportunity of resource stewardship in managing wilderness. However, to imply that the opportunity for resource stewardship comes only in wilderness environments would be ludicrous, because virtually all lands (public as well as private) entail various forms of resource stewardship.

Driver et al. introduced the benefit aspect of nurturance and recognized it as being "novel to the literature and a little more abstract and speculative" (p. 28) than other benefits. Specifically, nurturance benefits are those received by "altruistic people" who find pleasure in knowing that others, rather than themselves, can presently enjoy wilderness opportunities. The subtle distinction between nurturance and bequest values is that nurturance attaches values to present use, whereas bequest values are implied for future users.

Water Quality

Maintaining or enhancing water quality is generally considered to

be a high priority in the management of a wilderness resource (U.S. Dept. of Interior, BLM). In concept, this is perhaps one of the more persuasive arguments that attracts people to the idea of promoting wilderness, although the literature to date offers nothing to substantiate the idea that watersheds can be preserved and protected if and only if an area is designated as wilderness. The philosophy or intent of maintaining high resource standards and preservation principles through wilderness designation cannot be disputed in context, however. Water quality is therefore considered as being a beneficial characteristic in this taxonomic classification.

Air Quality and Visibility

Like water, air quality is a useful argument that the public and politicans can readily understand and support (Driver et al.). While the Wilderness Act of 1964 serves as a legal mandate for the protection of such attributes, it is interesting that statutory protection is provided for these areas for which the least biological information exists (Blankenship).

The Clean Air Act, which complements wilderness protection, is a more narrowly focused piece of legislation that identifies specific attributes to be protected and provides the regulatory tools to accomplish the mandate. Various management classifications come under the Clean Air Act. Depending on the classification requirement determined by individual states, various degrees of deterioration are permissable.

Biological organisms in wilderness that are exposed to air pollutants and acidic precipitation become directly affected through gas exchange mechanisms and surface depositions (Bennett et al.). In light

of legislative efforts to protect such organisms through wilderness designation and management, benefits can be realized with respect to the preservation of such environments. However, suppressing pollution sources in order to maintain wilderness characteristics is frequently a matter of concern even outside of designated boundaries. It must be recognized, therefore, that with the benefits of minimal negative pollution impacts come costs to society by way of suppressing opportunity for industrial growth and/or development outside a wilderness boundary.

Inherent/Intrinsic

Preserving the natural integrity of wildland ecosystems with respect to the benefits received by non-human organisms is a philosophy that is upheld by many proponents of wilderness designation. Driver et al. addressed this beneficial characteristic as one of three major categories in their review. They point out that these components of the wild ecosystem have interests, perhaps even rights. Furthermore, through human restraints the existence of wilderness "becomes a gesture of planetary modesty, an expression of humility and gratitude in the face of realities that transcend the short and probably ephemeral human endeavor. . . " (p. 54). Hendee et al. addressed this concept as a "biocentric philosophy" and contrasted it with anthropocentricism; the latter taking the "use and enjoyment" phrase of the Wilderness Act quite literally from the standpoint of man's direct use. Recognizing that wilderness was indeed meant to be enjoyed by people, they emphasized that the important distinction between these philosophies is the extent to which the human benefits of wilderness are seen as being dependent on the natural integrity of the wilderness setting.

Solitude or Primitive Unconfined Type of Recreation

A major objective of the 1964 Wilderness Act is to provide preserved and natural environments for the enjoyment of the American people. This implies enjoyment not only for the future, but also for the present. Historically, the most important component of wilderness benefits has been in the general area of recreational opportunities. For instance, in a survey of Colorado residents, Gillman found wilderness recreation benefits to be 37% greater than preservation benefits ($21.4 million as compared to $15.66 million, respectively).

The former discussion under the general classification of naturalness serves as the springboard for this next general level or classification of benefits--Solitude or Primitive Unconfined Type of Recreation. The following specific variables fall under this category.

Personal Development

Mental and Moral Restoration

Wilderness implies a reservoir for the renewal of mind and spirit (Hendee et al.). Arthur Carhart, the well-known landscape architect for the Forest Service in the early nineteen hundreds, believed that the greatest value of forests was their potential for building individual and national character. His persuasive preservation philosophy was instrumental in blocking a proposed development around Trappers Lake on the White River National Forest in Colorado. To him recreation and/or solitude in the great outdoors attached itself to strong moralistic values:

> Recreation in the open is of the finest grade. The moral benefits are all positive. The individual with any soul cannot live long in the presence of

> towering mountains or sweeping plains without getting a little of the high moral standard of nature into his being. (p. 269)

John Muir put it another way:

> Climb the mountains and get these good tidings. Nature's peace will glow into you as sunshine flows into trees. The winds will blow their own freshness into you and the storms their energy, while cares will drop off like autumn leaves. (from Teale, p. 332)

Wilderness, of course, lends itself to such attributes. It must be recognized, however, that some forms of primitive recreation and solitude that depend on wilderness settings are being threatened through overuse. Concentrated camping at conspicuous places within proximity to urban population concentrations, as well as season of use, are growing challenges for many wilderness recreation managers (Roggenbuck and Lucas).

Skill Development

Aldo Leopold believed that wilderness areas should be places where subsistence skills could be perpetuated (Leopold). In addition to survival skills, outdoor recreationists seek physical challenges offered in many wilderness settings such as rapelling cliffs or canoeing rapids in efforts to surpass their self-defined limits (Hendee et al.).

Therapeutic/Healing

Being able to trade the mundane pressures of urban life for the tranquility of wilderness settings has been credited with certain types of restoration of both mind and body. Among those groups who are said to benefit from programs carried out in wilderness settings are delinquents, psychiatric patients, drug abusers, and emotionally disturbed children (Driver et al.; Hendee et al.). Also, anyone who

just needs to escape the ringing of telephones, the bustle of congested city streets, the stress and/or monotony of day to day living--in short, anyone who longs for the sight of a pristine mountain setting--could benefit from a journey into the wilderness. Because the only way one can generally enter a wilderness area is on foot or on horseback, the physical exertion required just to get there may be therapeutic in itself (Driver et al.). However, as Driver et al. recognized, all the facts on such benefits are not clearly substantiated. It is not yet known whether these benefits are solely dependent on wilderness designation itself, or if they are just dependent on a change of environment or other outside influences.

Self-Sufficiency

Because of the very nature of wilderness designation and the restrictions it employs, anyone who desires a trek into the wilderness must generally rely on his own wits and outdoor survival skills. In a designated wilderness area there are no stores in close proximity--no Forest Service water taps in convenient locations. A backpacker or camper in a wilderness area must either pack in his supplies or fend for himself in the wild. Thus he learns the skill of self-sufficiency which may even carry over into his everyday life (Rossman and Ulehla).

Social Identity

In our society, family and friends are of great importance. However, in this era of upward mobility, when scrambling to start or maintain a career becomes an all-consuming passion, family and personal relationships are often neglected. Being able to disappear into the private, tranquil setting of a wilderness area with a select group of

family or friends may prove to be the catalyst for mending strained relationships, strengthening weak ones, or developing new ones (Cheek).

Esthetic/Creativity

One of the most obvious benefits of being in any natural setting is the esthetic value it holds. Such a setting provides inspiration and may even boost our creative processes. To be in the wild is to have the opportunity for solitude and contemplation--to be alone without being lonely. As Nixon Waterman said in his poem "Far From the Madding Crowd":

> It seems to me I'd like to go
> Where bells don't ring, nor whistles blow,
> Nor clocks don't strike, nor gongs sound,
> And I'd have stillness all around.
>
> Not real stillness, but just the trees,
> Low whispering, or the hum of bees,
> Or brooks faint babbling over stones,
> In strangely, softly tangled tones.
>
> Or maybe a cricket or katydid,
> Or the songs of birds in the hedges hid,
> Or just some such sweet sound as these,
> To fill a tired heart with ease. (p. 563)

Here again, however, it must be pointed out that wilderness designation is not necessarily a prerequisite for this type of activity unless the symbolism of being in the "wilderness" is inherently important to the person performing the activity.

Special Features

The third and last general category within this taxonomic classification of wilderness benefits is special features. As shown in table 1, this classification encompasses ecological, geological, scientific, educational, scenic, and historical values. The 1964

Wilderness Act specifically states that these special features may be included in wilderness. This however, implies they are not necessarily required. A discussion of each of these values follows.

Ecological

Representative Ecosystems

A primary objective of the Wilderness Act is to preserve an array of unique natural environments or ecosystems. To date, many different kinds of ecosystems are represented in the National Wilderness Preservation system. These ecosystems range among tundras, deserts, forests, and swamps located throughout the nation.

The benefit implied by maintaining representative ecosystems through wilderness designation is quite straightforward in concept. At the same time it would be inappropriate, if not impossible, to generalize from ecosystem to ecosystem and assess all consequences of disturbances if these areas were not protected. Driver et al. argue that the level of "uncertainty and the potential for irreversibility are reasons for preserving representative ecosystems at least until more knowledge is obtained. . . preventing unknown and unwanted costs from being disclosed in the future" (pp. 35-6).

Species Diversity

According to Driver et al., more definitive arguments have been made in the literature about the benefits of maintaining species diversity (or germ plasm) than about ecosystem preservation, even though the two are largely inseparable. Historically, such benefits have given rise to discoveries and advances in agricultural productivity, medical research, and industrial products from wild species (Myers). Driver et

al. admit that not all benefits derived from species diversity are attributed to wilderness. However, they do emphasize that by not knowing what demands are in store for new discoveries in the future, it "seems prudent to preserve species diversity" (p. 43) through wilderness preservation.

Due to the overlapping of the remaining values listed in table 1, as well as a lack of what Driver et al. call "systematic research", these remaining values will be grouped and discussed in two basic categories--geological and scenic; and scientific, educational, and historical.

Geological and Scenic

Indeed one of the motivating influences wilderness has for the general public is the assurance it offers that unique landforms and scenic vistas will be preserved. As discussed previously in the description of other values, this also tends to carry persuasive psychological connotations in support of wilderness designation. It must be recognized, however, that wilderness designation is not the only means to this desired end. Many other successful, less restrictive forms of management have been applied by virtually all public land management agencies.

Scientific, Educational, and Historical

The major scientific benefits of wilderness preservation are probably those that can be attributed to species diversity (Driver et al.). Moreover, wilderness can be used to study the natural processes of environments containing relatively little human disturbance. As "laboratories" for historical and scientific research, wildernesses may

serve as control areas for analyzing the effects of vegetative manipulation on water flows and soil erosion, as well as sources for understanding the dynamic characteristics of wildfires and infestations of insects and diseases. Driver et al. also argue that natural settings used in studying the characteristics of individual species and their environmental requirements, as well as identifying environmental trends are beneficial attributes of wilderness.

CHAPTER III

COSTS ATTRIBUTED TO WILDERNESS DESIGNATION AND MANAGEMENT

According to Workman et al. (p. 22), public recreational resources have for the most part been evaluated by economists with a focus on demand (value or benefit) and without reasonable consideration of supply (cost). With this focus on demand, non-market valuation of public land resources has typically yielded information for "all-or-none types of allocation in benefit cost analysis." They argue that even when marginal value estimates are known, decision makers have been and will continue to be "deprived of adequate information to render efficient resource allocation decisions unless correlative supply response/cost functions are made available." The usual assumption of perfectly elastic supply applied to non-market valuation research is a "convenient artifice" but is also "untenable" for most natural resource policy analyses. Similar arguments can be made for wilderness resources in general. The assumption that demand for increased wilderness acreage can be met without any additional cost to society is unrealistic.

The purpose of this section is not to attempt to offer supply response/cost functions with respect to wilderness designation and management, but to provide a listing or classification and discussion of specific cost variables as was done with benefits.

Table 2 presents an outline of the costs attributed to wilderness designation and management. It should be noted that each of these variables may or may not be specific components of all wilderness areas.

Table 2. Taxonomy of Wilderness Costs

I. Administrative/General Management Costs

II. Opportunity Costs
- A. Nonmechanized Recreational Overuse
- B. Vehicular Access/Recreation and Solitude
  1. Off-Road Vehicles (ORV's) such as snowmobiles, four wheel drives, all terrain vehicles (ATV's), and trail bikes
  2. Hunting and Fishing
  3. Social Identity
  4. Esthetic/Creativity
  5. Therapeutic/Healing
- C. Domestic Livestock Grazing
- D. Timber
- E. Mining and Mineral Resources
- F. Commercial User Permit Valuation
- G. Suppression of Industrial/Community Development Due to Clean Air Restrictions
- H. Tax Base
- I. Pending Water Rights
- J. Pest and Noxious Weed Control
- K. Ecological
- L. Weather Modification (Cloud Seeding)
- M. Wildlife Management
- N. Fire Control

However, they apply to wilderness designation in general. As with any public land management decision that involves tradeoffs, consideration of whatever is given up is necessary in order to determine net gain--or loss.

Administration/General Management Costs

Direct costs attributed to the administration and general management of wilderness areas can be significant. They may not, however, be adequately considered by decision makers. Irland (1979) reported that "direct costs are often substantial in relation to specific categories of direct benefits..." and "that there is entirely too little published information on this subject" (p. 60). Direct costs are frequently categorized as being either fixed or variable. The following discussion addresses such costs under these two categories.

In their study of backcountry management costs, Echelberger and Plumley reported that some studies have been conducted in the eastern and southeastern United States on this topic relating to fixed costs. For instance, they indicated that Tyre found average costs in the southeast ranged from $0.07 per visitor day for general, undeveloped lands to $0.27 per visitor day in wilderness areas. Guldin compared 1977 wilderness management costs of four areas in New England and found costs ranged from $1.80 to $8.37 per visitor day. Irland (1980) found that management costs on four different backcountry areas in Maine ranged from $1.36 to $4.98 per visitor day. In each of these studies opportunity costs were not included.

In Echelberger and Plumley's study, they investigated variable factors affecting operation and management costs for several dispersed

overnight site locations and backcountry trails as well. They found average annual costs ranged from $200 to $1500 per mile for trails and $0.35 to $4.29 per visitor for overnight sites. The average annual costs for trails and overnight sites increased with elevation and use levels. However, as one would expect, high-use trails cost less to maintain than low-use trails at all elevations when calculated on a per visitor basis.

Fixed and variable costs clearly vary from one wilderness area to another. Fixed costs may include a wide range of variables. Planning and program implementation, facility costs (including purchasing, installation, and construction of signs etc.), and operation and maintenance costs which occur annually covering personnel, vehicles, contracts, utilities, tools and materials are common fixed cost considerations for any wilderness proposal.

Variable costs can be adjusted to use levels and physical site characteristics of a wilderness area. Criteria used to measure the variable costs of wilderness use may be generated as a function of volume, frequency of use, and time of season. Physical site characteristics employ management actions to protect resources. These resources incur management costs that vary with labor costs, material costs, transportation costs, and administrative overhead (Echelberger and Plumley).

While direct administrative and management costs of wilderness areas can be substantial, it must be pointed out that they can also be relatively less than other traditional multiple-use managment options. For instance, a given resource area may in fact entail higher direct costs associated with timber or range improvement projects for a

management agency as compared with wilderness management options that may be less expensive in the long run.

Opportunity Costs

Opportunity costs are considered to be foregone opportunities. They usually do not represent actual transfers of cash. According to Irland (1979), this is especially true in wilderness decision making. For example, recreationists or a managing agency may not need to compensate anyone for the value of an unclaimed mineral deposit under a designated wilderness area. The variables discussed throughout the rest of this chapter represent such costs.

Nonmechanized Recreational Overuse

The recreational use of wilderness (primarily primitive forms) has historically led arguments favoring its designation. There is, however, evidence from specific cases that suggests that some forms of primitive recreation and solitude are (or could be) actually threatened through what is sometimes referred to as "the designation effect" (Roggenbuck and Lucas). In a survey of public land managers of wilderness, it was found that the most significantly perceived problem of wilderness management was that of local resource degradation and lack of solitude as a result of concentrated use (Washburne and Cole). This presents an interesting paradox with respect to the 1964 Wilderness Act's preservation objectives in that the benefits produced through primitive recreation and solitude are (or could) themselves be self-destructive to wilderness. Roggenbuck and Lucas admit that the idea of stimulating use by labeling an area as wilderness is an unsettled issue. Nonetheless, use patterns vary from one wilderness to another. The proximity of an

area to a large urban population center, as well as general characteristics conducive to esthetic preference are important considerations here.

According to Roggenbuck and Lucas, there is no consensus on the magnitude of projected recreation use in wilderness. For instance, Hof and Kaiser (1983a, 1983b) suggested that national annual average rates of growth for wilderness recreation use would be less than 1%, whereas Jungst and Countryman projected more than a 7% annual rate of growth. Roggenbuck and Lucas use these estimates in their review and indicate that over a forty-year time span a 1% growth rate per year would result in a 49% increase, while a 7% annual growth leads to 1,400% growth. Although not necessarily imminent, these speculations suggest that recreational overuse (hence cost) of wilderness resources could become a factor of concern in certain cases. This could also serve as a justification for adding more wilderness areas to the national wilderness preservation system to meet increased demand. This topic will be discussed in detail in the chapters that follow.

Vehicular Access/Recreation and Solitude

Off-Road Vehicles

With recreational opportunity in designated wilderness being primarily primitive, mechanized forms of recreation use are consequently precluded, and can generally be considered as opportunity costs. These forms of recreational opportunity costs generally revolve around vehicular access restriction. It appears that the most common forms of off-road vehicles (ORV's) restricted from designated wilderness areas include: snowmobiles, four-wheel drives, all-terrain vehicles (ATV's),

and trailbikes.

The use of ORV's on public lands has been represented by a growing number, as well as wide representation, of the general public over the last 20 years. Although snowmobiles, four-wheel drives, ATV's and trailbikes are not the only mechanized forms of recreation use, Clawson and Van Doren showed that mechanized travel from 1965-1982 consistently accounted for the second highest annual number of visitor days on all national forests combined. Further analysis of this data reveals an annual average percentage increase in mechanized recreation of 3.7% while overall recreation increased annually by 2.5% on average (see Appendix).

Hunting and Fishing

Fishing and hunting have long been major recreational activities on public lands. In fact, these two activities consistantly ranked 3rd and 4th, respectively, against 19 other major activities occurring on all national forests combined from 1965 to 1982 (Clawson and Van Doren). While wilderness designation implies enhancement of wildlife and fish habitat by fostering natural ecosystems with minimal human influence, there are related user groups who argue that access as well as management restrictions brought on by formal designation of wilderness threaten unique hunting opportunities on public lands. For example, the National Rifle Association (NRA) adopted a resolution in 1987 opposing wilderness designation due to its associated restrictions curtailing access for hunting and wildlife management opportunities. The NRA's resolution argues that such restrictions are "contrary to the best interest of wildlife conservation and responsible public enjoyment of wilderness lands" (Utah Farm Bureau News, p. 1). They claim that

wilderness regulations are an "abridgment of the rights of law abiding citizens."

Social Identity

This category was previously considered in the benefit discussion of Chapter II, because trips into the wilderness are credited with promoting a social bonding between participants. However, to the recreationist who enjoys packing up his family in the four-wheel drive and heading off to the high country for an afternoon or weekend of secluded (though accessible) camping, sightseeing, etc., wilderness designation may be perceived as a cost due to the restrictions it places upon vehicular access.

Esthetic/Creativity

When considering the benefits or costs that wilderness designation may hold in this category, one must ask just how far a person must go (into the wilderness, or just into a secluded natural setting?) in order to gain enjoyment from the experience. In the benefit portion of this thesis, Nixon Waterman's well-known poem "Far From the Madding Crowd" was quoted in order to illustrate the point that escaping from the frenzy of civilization for a time has a restorative effect and stimulates the creative senses. In the final two stanzas of his poem, perhaps Waterman offers insight to the question posed above:

> If tweren't for sight and sound and smell,
> I'd like the city pretty well,
> But when it comes to getting rest,
> I like the country lots the best.
>
> Sometimes it seems to me I must
> Just quit the city's din and dust,
> And get out where the sky is blue,
> And say, now, how does it seem to you? (p. 563)

Note Waterman's use of the word "country". This word carries with it the connotation of merely being out of the city, as stated in the last stanza. Therefore, the end of this poem suggests that the importance of an outdoor experience lies in simply being able to find the quiet and seclusion of nature. Thus, the restrictive nature of wilderness designation with regard to vehicular access may be considered as a cost. The rugged terrain associated with most primitive wilderness-type areas acts as a natural deterrent to excessive traffic. Those who wish to journey into such places must generally have the physical capabilities to do so. With wilderness designation restricting vehicular access to the point where people cannot get in close proximity to particular areas, however, lawmakers may be further restricting (perhaps unfairly) the numbers of people who can enjoy and benefit from the esthetic/creative opportunities these areas provide.

Therapeutic/Healing

This topic was discussed in Chapter II on the grounds that studies done by some psychologists indicate that so-called "wilderness therapy" may have a healing effect on some psychiatric patients as well as drug abusers and delinquent and emotionally disturbed children (Driver et al.). However, the hypothesis that the benefits derived from wilderness therapy are due to the wilderness area itself, or the designation thereof, rather than simply being in an isolated natural setting remains to be tested. According to Clinical Social Worker Barbara Quigley, the benefits derived from a "wilderness experience" depend upon the ingredients of everything applied--a basically natural setting where there is the necessity to trust other people and employ survival skills. Quigley pointed out that the physical characteristics

providing the experience are indeed an important consideration in regards to such therapy, although not nearly as important as the quality or format of the program applied.

Wilderness designation may be construed to be as much a cost as it is a benefit to the therapeutic/healing process when motorized access into wilderness areas is not allowed. This author does not pretend that every person who would benefit from an outing into a wilderness area could do so if it were not for the restrictions wilderness designation places upon vehicular access. But the possibility does exist that some patients who could benefit from such therapy who are capable of walking a quarter of a mile from a four-wheel drive on a dirt road to a secluded, primitive campsite would not be able to hike three, four, perhaps even ten miles to enjoy a similar experience.

Domestic Livestock Grazing

The 1964 Wilderness Act provides that certain uses, generally considered as "non-conforming" to wilderness environments, may continue after designation. Although congress has attempted to lay out specific guidelines for these non-conforming uses, inconsistencies in the interpretation of this act are apparent. In fact, the Wilderness Act specifically states that historical or traditional livestock grazing "shall" be continued in designated areas. However, it further points out that grazing is also subject to reasonable regulations or changes that might more readily comply with the preservation system. It appears that the subjectivity of such language leaves livestock permittees at an immediate disadvantage in this regard. Information formulated about relatively unimportant consequences by public land managers has and/or could seriously impede the effectiveness of various administration

programs (Hughes).

Organizations representing livestockmen have argued that existing as well as potential restrictions placed on livestock managers in some instances could go as far as making it impractical for them to continue using their grazing permits in designated wilderness areas. Many of these restrictions revolve around predator control, motorized access for feeding, salting, fencing, well and stock pond maintenance, and veterinary practices. In addition, range improvement practices such as reseeding and brush control will likely not be considered in future management plans involving designated wilderness areas. In this regard wilderness designation can be viewed as a cause for such impositions, thus presenting an opportunity cost.

Timber

Most wilderness controversies have included timber resources. In fact, the timber industry has historically been a major opponent to various wilderness bills simply because these bills have generally restricted most traditional commercial uses of public land. Timber supply impacts of wilderness withdrawals tend to be low on a per acre basis according to Irland (1979). However, the major opportunity cost of wilderness designation relative to timber harvest comes through the reduced resource supplies that may place heavy burdens of adjustment on local communities and individuals.

The dependence of local communities, as well as regions and states, on the timber industry varies widely across the United States. For example, Irland (1979) contrasted employment levels in various regions and reported that the timber industry accounted for 13 percent of manufacturing jobs in the south, against 43 percent of Idaho's, and 41

percent of Montana's manufacturing jobs in the Rocky Mountain region. Furthermore, Irland reported that Maki and Schweitzer evaluated this economic dependence in the Douglas-fir region communities of western Oregon and Washington and "found that 40% of the region's excess employment--jobs attributed to export of goods outside the region--was from the timber-related industry. Within this region, dependence on timber ranged from 2% in Seattle to 98% in Roseburg, Oregon" (p. 121).

Although these data do not necessarily offer a direct estimate of the effect of a given reduction in log production that wilderness could create, they do offer a reading of the varying importance the timber industry has among different communities.

It must also be stated that job losses in any primary industry, such as timber, may underscore local economic impact. This is due to the multiplier effect of expenditures and payrolls in such industries. These outlays support jobs and incomes in service and supply sectors of the local economy (Irland, 1979).

Mining and Mineral Resources

Like timber, mining and mineral resources have had a significant role in the controversies associated with wilderness legislation. The Wilderness Act of 1964 can clearly be interpreted as being less restrictive to mining claims (in the long run) in comparison to petroleum energy extraction. This is because mineral exploration was allowed to continue in wilderness areas until 1983, while mining development was permitted on existing valid claims, even after 1983. Nonetheless, wilderness designation has generally created substantial barriers to mineral development and mining. This is primarily due to excessive extraction costs if not exclusion from development in order to

maintain wilderness characteristics.

Up until the last decade, the impacts of wilderness designation on speculative production supplies of national energy and other mineral resources was quite low with the exception of a few areas (Irland, 1979). More recently, however, such arguments have not been as valid. This is probably due to two reasons. First, the National Wilderness Preservation System (NWPS) more than doubled in size from approximately 16.1 million acres in 1977 to 32.7 million acres in 1986--and even further expansion is planned. Millions of acres of predominantly BLM lands are now being considered for wilderness designation throughout the western United States. This additional acreage will undoubtedly include lands that have proven mineral resources. Second, very little of this nation's land surface has ever been explored for minerals using sophisticated geophysical methods. As such methods are applied with techological advances through time, it is likely that areas that were once considered low for potential energy extraction and mining activity could be looked upon much differently in the future. Moreover, cumulative technological change allows industry to extract useful products from ores of lower and lower grade. This process helps make many deposits recoverable that were not economically feasible at previous cost/price relationships.

Restrictions imposed on mining and mineral resource extraction on wilderness lands can clearly be viewed as a cost to resource dependent rural communities as was argued under the timber category in this chapter. In all fairness, however, it must also be recognized that while restrictions may suppress economic activity for a given community or group, there can also be preservation benefits realized through such

restrictions as was discussed in Chapter II.

Perhaps Irland (1979) addresses this cost/benefit relationship best:

> Future needs for minerals, oil, and gas will continue to conflict with the requirements of preservation. Each individual situation will have to be judged on its own merits, in terms of the significance of the area affected, the alternative sources of the mineral involved, and reclamation opportunities. Resolving these questions will challenge resource managers, the public, and the Congress for generations to come. (p. 107)

Commercial User Permit Valuation

Public lands cannot be treated as private property by any commercial user. Yet various permits sold by the federal government to private entities for commercial use such as domestic livestock grazing, recreation, hunter outfitter guiding, etc., often take on value beyond the actual costs of such permits. Typically, these values of permitted use do not directly affect the worth of private properties affiliated with such activities. Any impacts affecting the use of a permit, however, may in turn affect its value. Wilderness designation has potential impacts relating to these circumstances and in some instances creates opportunity costs.

As a case in point, the 1984 BLM Wilderness Draft Environmental Impact Statement for the proposed Bitter Creek Wilderness Area in northeastern Montana recognized that wilderness designation could negatively affect values of surrounding livestock operations (Bitter Creek Draft Wilderness Suitability Study and EIS). The findings were documented by a survey conducted by Agricultural Management and Economic Consulting based on contacts made from a variety of officials including representatives of the Federal Land Bank Association, the Farmer's Home

Administration, the Production Credit Association, and several insurance company representatives and realtors.

On the other hand, wilderness designation could actually enhance user permit values where commercial operations cater to activities revolving around primitive recreation or hunting.

Suppression of Industrial/ Community Development Due to Clean Air Restrictions

The provisions for clean air in maintaining wilderness characteristics have generated much concern over the consequential suppression, if not exclusion of energy development and economic growth of local communities and regions. Such costs are attributed to lands not only located within wilderness boundaries, but outside of them as well. This is because wilderness characteristics can be negatively affected if they are in close proximity or downwind from major sources of air pollution. Examples of various air pollution/economic growth conflicts include the proposed Kaiparowitz energy generation project in southeastern Utah and the Upper Colorado River Basin.

The tradeoffs associated with clean air restrictions and meeting the demand for energy and economic development will continue to be a major challenge for decision makers in years to come. As more information becomes available regarding biological consequences of air pollution, and as economic forecasting becomes more precise, perhaps future decisions will be less controversial.

Tax Base

Although no empirical information exists to date on the negative or positive impacts wilderness designation has upon tax bases, it has been

presented as a concern by wilderness opponents even prior to the passage of the Wilderness Act of 1964. Conventional arguments against wilderness designation such as suppression of community development, loss of revenues through restricted timber harvesting, mechanized recreation, potential interference with livestock operations, and discrimination of mining and petroleum activities clearly suggest that negative impacts could be imposed in various local and state tax revenues. However, the magnitude of such impacts on tax revenues is of course a function of the degree to which such industrial development is affected.

Perhaps more often than not, areas that have been considered for wilderness designation have focused primarily on the economic impacts internally associated within the boundary of a designated area. As mentioned previously, clean air restrictions inherently imposed by such designation can and have in fact dictated what type of industrial development may occur even outside of a wilderness boundary. This particularly holds true with energy generation projects which potentially offer substantial revenues and tax support for local as well as state economies.

Pending Water Rights

A major issue surrounding recent wilderness legislation is federal claims to reserved water rights. Section 4(d)(7) of the 1964 Wilderness Act addresses this issue. Specifically, it states that "Nothing in this Act shall constitute an express or implied claim or denial on the part of the federal government as to exemption from state water laws." Unfortunately, a great deal of controversy has evolved from various interpretations of this language in recent years.

The complications implied by a recent Colorado court ruling on federal reserved water rights in wilderness areas has basically set the stage for serious impacts that could impede water developments. The court ruling essentially requires a federal managing agency to comply with the statutory duty to protect wilderness water resources, and that reserved rights are inherent to such legislation. It does not, however, specifically address the quantity or quality of water necessary to meet this charge. Various organizations, such as Mountain States Legal Foundation, argue that unquantified interpretations of such law could in fact jeopardize water users' ability to divert water in or upstream from these areas.

Although it is believed that Congress has never taken a position to intentionally harm vested rights, they have not as yet addressed this controversy in dealing with water rights directly. Instead it has been essentially left to the courts to interpret on a case by case basis.

The majority of designated wilderness areas presently exist on higher elevation sites or upper-reaching forested lands. Due to this, federal reserved water rights have not been an issue of as much concern as they will be in the future. This is because many of the proposed wilderness areas now under consideration are on lower reaches of BLM lands where water diversion and use is subject to more public scrutiny.

Pest and Noxious Weed Control

As with petroleum, mining, and livestock grazing the Wilderness Act of 1964 established special provisions for the control of insects and diseases within designated areas. However, such provisions are subject to the management objectives of the preservation system.

The subjectivity of restricted use of herbicides or pesticides has

surfaced concerns by various user groups, particularly those representing agricultural interests. Such concerns relate to restrictions imposed not only within designated wilderness areas, but outside of them as well. Serving as a case in point, the public hearing sponsored by the Bureau of Land Management over its Utah Statewide Wilderness Draft Enviromental Impact Statement generated many comments from farm and livestock operators and representative organizations. The Utah Farm Bureau's testimony, for instance, used the example of the Mormon cricket control dispute concerning the threats imposed on the peregrine falcon's habitat in Dinosaur National Monument. In this case, insecticide application on lands outside of the monument boundary was challenged by environmental groups. It was Farm Bureau's belief that a parallel between National Park and National Wilderness management objectives could set the stage for similar kinds of conflicts (Utah Farm Bureau Federation).

The future control of insects and other pests and noxious weeds, both inside and outside of wilderness boundaries, demands more attention from national lawmakers. An added argument that ties to this concern, is the fact that such areas could give a competitive advantage to various troublesome plant and animal species and potentially serve as untouchable problem sources for many private landowners and other agencies as well.

Ecological

The ethic of today's environmental movement appears to call for man's adjustment to nature rather than degradation of it with intensive applications of technology. Wilderness legislation certainly supports this ethic through its intentions of preserving and protecting natural

environments.

In contrast to this preservation land ethic, however, Ditwiler argues that modern technology can be used directly to alleviate problems associated with man's use of natural environments. He presents his argument in this way:

> Many governmental natural resource programs reflect the notion that environmental concerns should dominate decisions regarding natural resource use. The federal and state agencies charged with producing natural resource oriented services have been given much of the responsibility for managing the natural resource base traditionally used in the production of the services. This responsibility tends to legitimize the traditional "nature-dominant" input/output relationships; this perspective has inadvertently focused attention away from the potential benefits to be derived from changing the input base for the production of goods and services which have traditionally been derived directly from elements in the natural environment. We have not given adequate attention to the possibility of orienting our production functions around an artificial environment rather than the natural environment. (p. 106)

In its present sense, wilderness designation basically precludes man-altered environments. Considering the amazing technological advancements that have occurred over the last century relative to man's existence, however, these preserved environments could be ecologically enhanced through application of future natural resource technological discoveries. An example of this argument has been demonstrated in the agricultural field. Technological advancements have bolstered production levels of various commodities that would have been incomprehensible to a farmer of the early 1900's. These advancements have been accomplished in a myriad of ways such as discovery of disease- and/or drought-tolerant seed strains, etc. Perhaps similar opportunities await us in timber and rangeland resources which are typically major elements of wilderness environments.

Weather Modification

In an effort to augment water supplies in the arid regions of the intermountain west, weather modification through cloud seeding has been applied over the last decade with varying degrees of popularity and success. Irland (1979) reported that the Bureau of Reclamation intended to pursue weather modification techniques in the late 1970's with intentions of increasing water supplies as much as 4-5% in the western states outside of the Columbia Basin.

As technological advances continue to progress in this area, cloud seedings conceptually may have the potential to create subtle forms of environmental change in wilderness areas. Although water conservation works are considered to be acceptable in the 1964 Wilderness Act pending presidential approval, there more than likely will be controversy generated and efforts formed to block such man-induced modifications in the future.

Wildlife Management

Wilderness designation has often been credited with offering a positive influence on wildlife habitat. It is quite inappropriate, however, to assume that all forms of wildlife benefit from wilderness designation (Nish).

Ideally, a wilderness area is maintained in advanced seral stages of ecological succession. According to Nish, some species of wildlife such as deer and elk are most productive at intermediate seral stages of succession. The potential for "optimal" production levels of such big game species can actually be lessened when man-induced management tactics such as pinyon juniper chainings or lodgepole pine openings are restricted. As a case in point, the Utah Department of Wildlife

Resources suggested that portions of Utah's High Uintas Wilderness boundary be moved towards upper reaches of various lodgepole tree stands to enable management options generally not compatible with wilderness designation.

In contrast to this argument, however, there are indeed many species of wildlife such as the grizzly bear and wolf, that benefit from the lack of human activity or development. Nish contends that wilderness proposals need to be evaluated on a case by case basis in order to accurately assess benefits or costs to wildlife habitat.

Fire Control

The "let burn" policy commonly applied to wilderness areas has become an issue of considerable debate. While wilderness proponents argue that naturally induced fires should be allowed to take their own course in such areas, others contend that exclusion of mechanized equipment for fire control is impractical and costly. Such policy is superceded by provisions for public safety, however. In the advent of serious threat, approval for the use of mechanized equipment can be granted.

The opportunity costs associated with fire management in wilderness areas can perhaps be best exhibited by drawing a parallel with what occurred in the 1988 Yellowstone National Park fire. Although a national park is not an official designated wilderness area, the fire management policy employed by the National Park Service resembles fire management policy for wilderness. Furthermore, adjacent wilderness areas were affected by that fire. Some experts consider the initial management tactics which restricted mechanized equipment to combat that fire resulted in unnecessary losses and/or costs.

CHAPTER IV

STUDY PROCEDURE

The empirical portion of this thesis offers relative comparisons of wilderness and non-wilderness recreation use on USFS lands in Utah, Region 4, and the overall national Forest Service system from 1967 to 1986. The High Uintas Wilderness area is also analyzed for its use over the same twenty-year period. Data used for this analysis was obtained from USFS's Intermountain Regional Office, where annual recreational use estimates are stored on microfilm and other related sources.

The system used by the USFS to quantify annual recreational use of its lands is a computer oriented system known as Recreation Information Management (RIM). It essentially has served as the USFS's system of compiling and reporting uniform recreational use information over the last 23 years. Although the system has been criticized at times for its inaccuracy, RIM offers the only uniform source of such information and has also helped serve as the basis for budgetary and management decisions since its inception. Furthermore, in satisfying this thesis' objective of establishing growth rates, the magnitude of the values offered by RIM are not as important as are the relative changes in the values that are occurring year by year over time. In this respect, RIM data tends to have greater credibility, since any given local management entity or district generally is accurate in recognizing whether or not it experienced more, the same, or less recreation use relative to the previous year or years.

The USFS estimates recreational use for RIM in "recreational

visitor days", commonly referred to as RVD's. By definition, a visitor day constitutes 12 person hours. It may entail 1 person for 12 hours, 12 persons for 1 hour, or any equivalent combination of individual or group use, either continuous or intermittent. All values used throughout this study are expressed in RVD's as well.

Two major classifications of recreational use are offered through RIM--developed and dispersed. The following elements under each of these classifications are USFS guidelines which help distinguish between the two (USDA Forest Service).

Developed sites	Dispersed
Campgrounds	Roads
Hotels and resorts	Trails
Boating sites	Waters
Winter sport sites	General undeveloped areas
Swimming sites	
Interpretive or information sites	

Each distinctive element supports a typical complex of recreation activities. For instance, the element of "general undeveloped areas" listed above is partly comprised of wilderness and primitive area composites which can be broken down into various forms of recreation activities such as hiking and walking, horseback riding, camping, picnicking, cross country skiing, hunting, studying nature, or mountain climbing.

The USFS classifies wilderness and primitive area recreation use in combination as a specific sub-element of dispersed recreation. In meeting the objective of analyzing wilderness and non-wilderness recreation, this thesis examines two forms of recreation use: 1)

wilderness/primitive recreation and 2) non-wilderness/primitive recreation.

Growth rate comparisons of these two forms of recreation use are examined for relative differences at Utah, Region 4 and overall national forest system levels. Growth rate of recreational use in the High Uintas Wilderness/Primitive area is also examined for further insight of the dynamics of Utah's overall wilderness/primitive recreation use patterns. All recreational use measurements are expressed in general terms (1000's of RVD's), as well as on a per acre basis.

Perhaps the most appropriate comparisons of recreational use at various levels are those that are measured on a per acre basis. This is because more accurate relative comparisons are expressed in this form. Moreover, and most important, the concept of marginality can be applied here. The reasoning behind this fundamental economic concept as it applies to this study can be visualized in the relationship between the following two ratios:

$$\frac{\text{Non-Wilderness/Primitive RVD's}}{\text{\# Respective Acres}} \quad \text{vs} \quad \frac{\text{Wilderness/Primitive RVD's}}{\text{\# Respective Acres}}$$

Theoretically, the relationship between these two ratios suggests that any increase in wilderness/primitive acreage is obtained from that of non-wilderness/primitive acreage. The values applied to each of the two numerators are respective amounts of recreation use occurring in any given year that have been estimated and provided by the USFS. The relative differences that occur over time in the ratios of these two expressions are of particular importance here. Specifically, if one ratio is decreasing relative to the other ratio, then the "marginal use" of that particular form of recreation is decreasing as well. This would

suggest that its marginal value is also decreasing. Growth rates of recreation use expressed on a per acres basis in this study are general indicators of such marginal value either increasing or decreasing.

Statistical Analysis

Compounded rates of growth of various forms of recreation use on USFS lands from 1967 to 1986 were estimated from RIM data as outlined above. The functions derived in this analysis represent best fit estimates through application of the ordinary least-squares regression technique. All regression results represent specifications of the array of RIM data applied against time. As with most analyses of this type however, some model resolution is lost with such estimation because fitted regression lines, as expected, do not explain 100 percent of the variation in the dependent variable (RVD's). However, a "satisfactory" fit was obtained for each equation based upon "goodness and confidence-of-fit" indicators including $\bar{R}^2$, F, and t-statistics.

The following least-squares regression equation was used as the basis for all computed growth rate estimates in this analysis:

(1.1) $$Y_t = \alpha + \beta t + E_t \quad (t = 1,2,3,\ldots,n)$$

where Y_t = dependent variable (the amount of RVD's in year t)

α = intercept term

β = estimated regression coefficient

t = independent variable (time)

E_t = error term, assumed to be normally and independently distributed with zero mean and constant variance.

Least-squares compounded growth rates were estimated by fitting a least-squares linear trend line to the logarithmic annual values of the

dependent variable in the relevent time period. More specifically, the regression equation (1.1) takes on the form:

(1.2) $\ln Y_t = \alpha + \beta t + E_t$

Equation (1.2) is equivalent to the logarithmic transformation of the compound growth rate equation:

(1.3) $Y_t = Y_o(1 + g)^t e^{E_t}$

In logarithmic terms, equation (1.3) becomes:

(1.4) $\ln Y_t = \ln Y_o + t\ln(1 + g) + E_t$

where Y_t = amount of RVD's in year t

Y_o = a parameter representing the intercept term

g = a parameter which is the compound rate of growth of Y_t

E_t = the disturbance term

e = a constant term that is approximately 2.718

Aligning equation (1.2) with (1.4), $\alpha = \ln Y_o$ and $\beta = \ln(1 + g)$. $\hat{\beta}$ is a least-squares estimate of β:

(1.5) $\hat{\beta} = \ln(1 + g)$

The compounded rate of growth, or estimated annual average growth rate, $\hat{g}$, can be obtained by solving for g in equation (1.5):

(1.6) $\hat{g} = (\text{antilog } \hat{\beta}) - 1$

Finally, by multiplying $\hat{g}$ by 100, percent compounded rate of growth is then derived.

As a technical note, it should be pointed out that $\hat{g}$ is not a linear function and therefore it is not unbiased. It is, however, consistent.

Positive Autocorrelation

A feature common to time series regression analysis is positive autocorrelation, which is sometimes referred to as autoregression or

serial correlation. This condition exists when the disturbance occurring at one point of observation is correlated with other disturbance from a previous observation. Since one of the assumptions of the classical linear regression model is that the disturbance terms from one observation against another are independent, then regression estimates must be adjusted for if positive autocorrelation is detected. In cases where it was statistically shown through the application of the Durbin-Watsin statistic that positive autocorrelation was present, then regression estimates were adjusted by using the Prais-Winsten iterative procedure (see Kmenta).

The null hypothesis tested through application of the Durbin-Watsin statistic (see Kmenta) for all least-squares regression analyses in this thesis was that the autocorrelation coefficient, ρ or rho, was equal to zero at the $\gamma = .05$ level of significance. Rho values are listed in the results of each analysis for quick reference.

The Coefficient of Determination: $\bar{R}^2$

As mentioned previously, a standard "goodness-of-fit" indicator for least-squares regression is $\bar{R}^2$. This statistic represents the relationship between the dependent and independent variables, RVD's and time, respectively. More specifically, $\bar{R}^2$ is referred to as adjusted R^2, which is simply an R^2 measurement corrected for degrees of freedom. By definition, both terms reflect the proportion of the variation in the dependent variable explained by the variation in the independent variable. However, because of $\bar{R}^2$ being "adjusted" for degrees of freedom it is considered a more accurate estimate of such variation (Kennedy). Like Rho values, $\bar{R}^2$ has been entered in the results of each analysis.

Test of Hypotheses

A primary hypothesis test applied to all least-squares regression estimates in this analysis was whether or not growth rates were statistically significant. Since growth rate estimates are strictly a function of $\hat{\beta}$ in this instance (see equation (1.5)), the null hypothesis for each individual test of this type was H_o: $\beta = 0$, measured at the $\alpha = .05$ level of significance. The following is an outline of the specific areas to which this test was applied:

(1a) Total recreation use (general) on USFS lands in Utah, Region 4, and nation, 1967-1986.

(1b) Total recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1986.

(2a) Non-wilderness/primitive recreation use (general) on USFS lands in Utah, Region 4, and nation, 1967-1986.

(2b) Non-wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1986.

(3a) Wilderness/primitive recreation use (general) on USFS lands in Utah, Region 4, and nation, 1967-1986.

(3b) Wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1986.

(4a) Non-wilderness/primitive recreation use (general) on USFS lands in Utah, Region 4, and nation, 1967-1976.

(4b) Non-wilderness/primitive recreation use (general) on USFS lands in Utah, Region 4, and nation, 1977-1986.

(5a) Non-wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1976.

(5b) Non-wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1977-1986.

(6a) Wilderness/primitive recreation use (general) on USFS lands in Utah, Region 4, and nation, 1967-1976.

(6b) Wilderness/primitive recreation use (general) on USFS lands in Utah, Region 4, and nation, 1977-1986.

(7a) Wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1976.

(7b) Wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1977-1986.

(8) Recreation use (general) on USFS High Uintas Wilderness/ Primitive Area, 1967-1986.

(9a) Recreation use (general) on USFS High Uintas Wilderness/ Primitive Area 1967-1976.

(9b) Recreation use (general) on USFS High Uintas Wilderness/ Primitive Area, 1977-1986.

(10) Recreation use per acre on USFS High Uintas Wilderness/ Primitive Area, 1967-1986.

(11a) Recreation use per acre on USFS High Uintas Wilderness/ Primitive Area, 1967-1976.

(11b) Recreation use per acre on USFS High Uintas Wilderness/ Primitive Area, 1977-1986.

(12a) Recreation use (general) on net USFS (High Uintas excluded) Utah wilderness/primitive areas, 1978-1986.

(12b) Recreation use per acre on net USFS (High Uintas excluded) Utah wilderness/primitive areas, 1978-1986.

Chow Test

RVD's were plotted against time with respect to the various forms of recreation use at the different levels described above. Upon doing so, it became visually evident that some forms of recreation use did not exhibit consistent growth trends over the twenty-year period studied. This was most typically observed with respect to wilderness/primitive recreation use per acre at virtually all levels examined.

A statistical test known as the "Chow test" (Chow) was therefore applied to test whether or not recreation use during two time frames (1967-1976 and 1977-1986) within the twenty-year study period (1967-1986) were significantly different. This test was applied to the specific recreation use descriptions (2a), (2b), (3a), (3b), (8), and (10) above. Each set of data from these descriptions initially had least-squares regression coefficients estimated from 1967-1986. Subsequently, these sets were then "collapsed" by running two separate regression estimates from 1967-1976 and 1977-1986, respectively, as explained in recreation use descriptions (4a), (4b), (5a), (5b), (6a), (6b), (7a), (7b), (9a), (9b), (11a), and (11b) above. Sum of squares of the residuals (SSE) from each regression were then applied to the following F statistic:

$$\frac{(SSE_c - SSE_1 - SSE_2) / K}{(SSE_1 + SSE_2) / (n + m - 2K)} \qquad F^{K}_{n + m - 2K, .05}$$

where SSE_c = sum of squares of residuals from combined regression (1967-1986)

SSE_1 = sum of squares of residuals from period one regression (1967-1976)

SSE_2 = sum of squares of residuals from period two regression (1977-1986)

K = number of restricted coefficients

n = number of observations in period one

m = number of observations in period two

The null hypothesis for each individual application of the Chow test of this type was H_o: $\alpha_o = \alpha_1$, $\beta_1 = \gamma_1$ from the standard regression forms:

1) (1967-1976) $\ln Y = \ln\alpha_o + t\ln\beta_1$

2) (1977-1986) $\ln Y = \ln\alpha_1 + t\ln\gamma_1$

where α_o = intercept term for period one

β_1 = regression coefficient for period one

α_1 = intecept term for period two

γ_1 = regression coefficient for period two

t = independent variable (time)

Comparison of Recreation Use and Growth Rate Estimates

Recreation use and growth rate estimates were expressed in comparative form graphically and in corresponding tables at various levels examined. For example, total recreation use and growth rate estimates were reported in Utah, Region 4, and the nation in one graph and table, respectively. The visual comparisons offered by graphing RVD's against time in this manner are essentially straightforward. Growth rate comparisons are self-evident as well, and discussed in detail in Chapter V. Theoretically, however, it should be mentioned that such growth rate comparisons can be considered mathematically by taking the derivative of each regression equation (from equation 1.1)

which yields β, the regression coefficient (or slope of the line) for all cases considered in this analysis:

$$Y_t = \alpha + \beta t + E_t \qquad \text{(from equation 1.1)}$$

$$\frac{dY_t}{dt} = \beta$$

As mentioned previously, growth rate estimates in this analysis are strictly a function of regression coefficients (see equation 1.5). Therefore, it is appropriate to discuss relative differences in such terms as they appear, particularly since each individual regression coefficient was statistically tested at the $\alpha = .05$ level of significance.

CHAPTER V

RESULTS AND DISCUSSION

The benefit/cost variables identified and discussed in Chapters II and III clearly present a challenge for economists and decision makers considering changes in public land classifications relating to wilderness designation. An initial objective of this thesis was to isolate an existing wilderness area and offer a detailed economic analysis of the measurable costs and benefits associated with its designation and management. This initial effort was thwarted by a lack of necessary information from Forest Service records and other sources.

Prefacing the results of the revised objective which addresses trends of recreational use of wilderness and non-wilderness areas as explained in Chapter IV, it should be pointed out that this procedure was chosen primarily because of the availability of information. Perhaps this experience will offer some warnings to future researchers in this area.

Every effort has been made to minimize confusion in the layout of the results of this analysis. Actual recreation use values (RVD's) on USFS lands at all levels examined are presented in a corresponding table on the page that immediately precedes the respective graphs and growth rate estimates.

The various forms of recreation use at all levels examined are reported in general terms (1000's of RVD's), as well as on a per acre basis. Acreage used to measure RVD's on a per acre basis is determined by the form of recreation use for which it is applied. For instance,

wilderness recreation use per acre in Utah is a function of the reported USFS wilderness RVD's in Utah in any given year applied to the respective amount of reported USFS acreage in Utah for that same year where wilderness recreation could theoretically occur (all USFS acres in Utah designated as wilderness).

Total Recreation Use (Utah, Region 4, and Nation)

Total USFS recreation use in general terms (1000's of RVD's) from 1967 to 1986 ranged from 6,493.6 to 13,179.4 in Utah; 15,090.0 to 25,902.7 in Region 4; and 149,647.1 to 226,532.7 nationally (see table 3 and figure 2). Percent compounded rates of growth estimated at these levels over the same twenty-year period were 3.861%, 2.856%, and 2.215%, respectively (see table 4).

To present a more accurate relative comparison, however, total USFS RVD's per acre ranged from .82 to 1.65 in Utah; .49 to .83 in Region 4; and .82 to 1.21 nationally during the same period (see table 3 and figure 3). Growth rates measured in this form were 3.833%, 2.816%, and 2.097%, respectively (see table 5).

These statistics indicate that growth rates ranked highest in Utah, followed by Region 4, and finally the nation under both forms of analysis. However, RVD's per acre consistently ranked highest in Utah, followed by the nation, and then Region 4 each year observed (see table 3 and figure 3).

Non-Wilderness/Primitive Recreation Use (Utah, Region 4, and Nation)

Table 6 outlines non-wilderness/primitive recreation use on USFS

Table 3. USFS Total RVD's and Acreage (Utah, Region 4, and Nation), 1967-1986

YEAR	UTAH			REGION 4			NATION		
	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	6,493.6	.82	7,937,473	15,090.0	.49	30,819,175	149,647.1	.82	182,507,377
1968	6,953.9	.88	7,944,538	16,606.2	.54	30,846,261	156,655.3	.86	182,615,576
1969	7,389.0	.93	7,967,857	17,524.2	.57	30,974,707	162,838.1	.89	182,340,141
1970	8,264.3	1.04	7,969,951	18,736.9	.61	30,949,882	172,554.5	.95	182,571,102
1971	9,604.0	1.20	7,971,867	20,944.9	.68	30,975,759	178,110.0	.98	182,578,296
1972	10,608.1	1.33	7,987,081	23,164.6	.75	31,004,495	183,958.3	1.01	182,773,942
1973	10,314.2	1.29	7,995,365	22,390.1	.72	31,041,496	188,174.7	1.03	183,014,294
1974	10,411.7	1.30	7,991,474	21,734.9	.70	31,022,512	192,915.8	1.06	182,045,476
1975	9,737.8	1.22	7,991,938	21,839.7	.70	31,035,411	199,200.8	1.09	183,280,072
1976	11,151.0	1.40	7,990,036	23,110.5	.74	31,034,242	199,928.1	1.09	183,380,761
1977	11,342.0	1.42	7,990,271	23,514.4	.76	31,042,052	204,797.4	1.12	183,447,427
1978	11,780.2	1.47	7,990,239	24,319.1	.78	31,081,801	218,494.3	1.19	183,554,842
1979	12,501.1	1.56	7,990,551	25,456.1	.82	31,083,860	220,165.6	1.20	183,186,893
1980	14,061.0	1.76	7,990,244	27,191.6	.87	31,084,987	233,549.3	1.28	183,060,464
1981	14,417.5	1.80	7,990,161	28,223.4	.91	31,085,728	235,709.2	1.26	186,441,602
1982	14,790.7	1.85	7,990,329	28,121.9	.90	31,087,893	233,437.5	1.25	186,559,221
1983	13,330.4	1.67	7,989,521	26,510.5	.85	31,087,119	227,707.8	1.22	186,531,949
1984	13,621.1	1.70	7,989,733	26,389.8	.85	31,087,915	227,553.9	1.22	186,383,802
1985	13,914.3	1.74	7,990,710	26,604.6	.86	31,100,208	225,407.3	1.21	186,315,499
1986	13,179.4	1.65	7,987,561	25,902.7	.83	31,105,730	226,532.7	1.21	186,463,004

Source: USDA, Forest Service

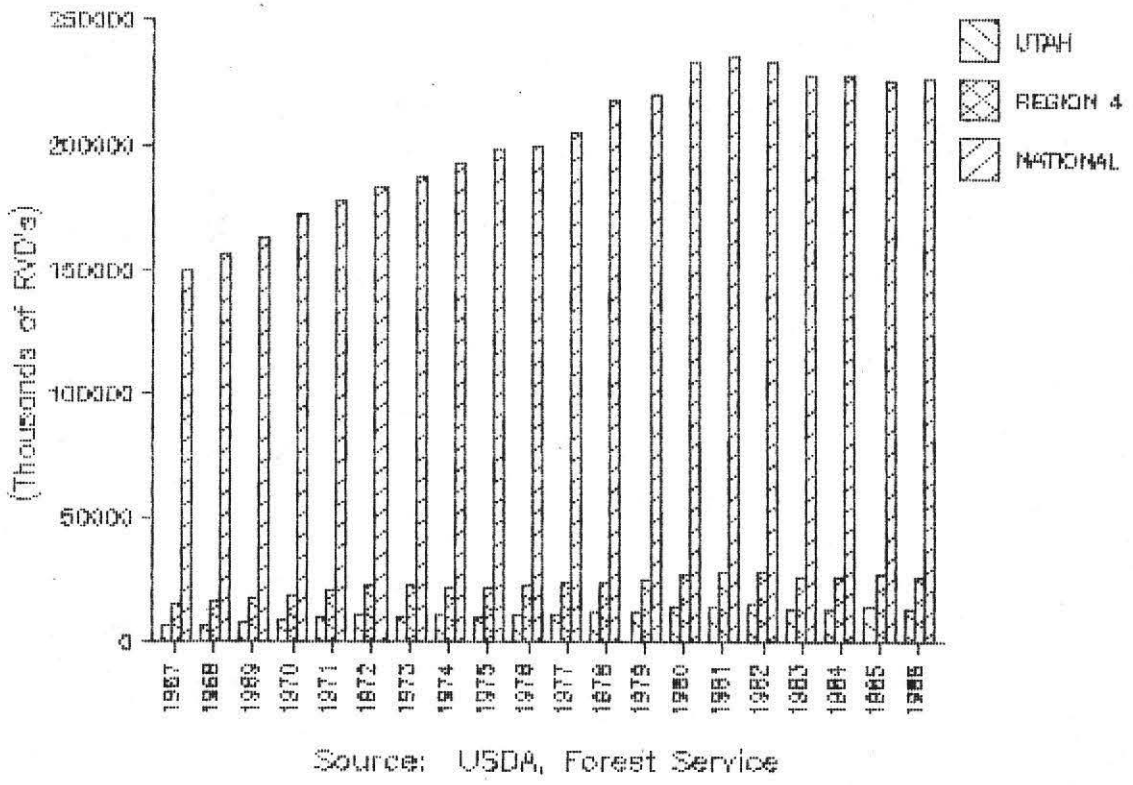

Figure 2. Total recreation use on USFS lands in Utah, Region 4, and nation, 1967-1986

Table 4. Growth Rate Comparisons and Regression Statistics of Total Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	3.861a	.0378876b (.008051)	.84600	.802594
Region 4	2.856a	.0282452b (.007422)	.80468	.893855
Nation	2.215a	.0219047b (.004476)	.88487	.938645

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

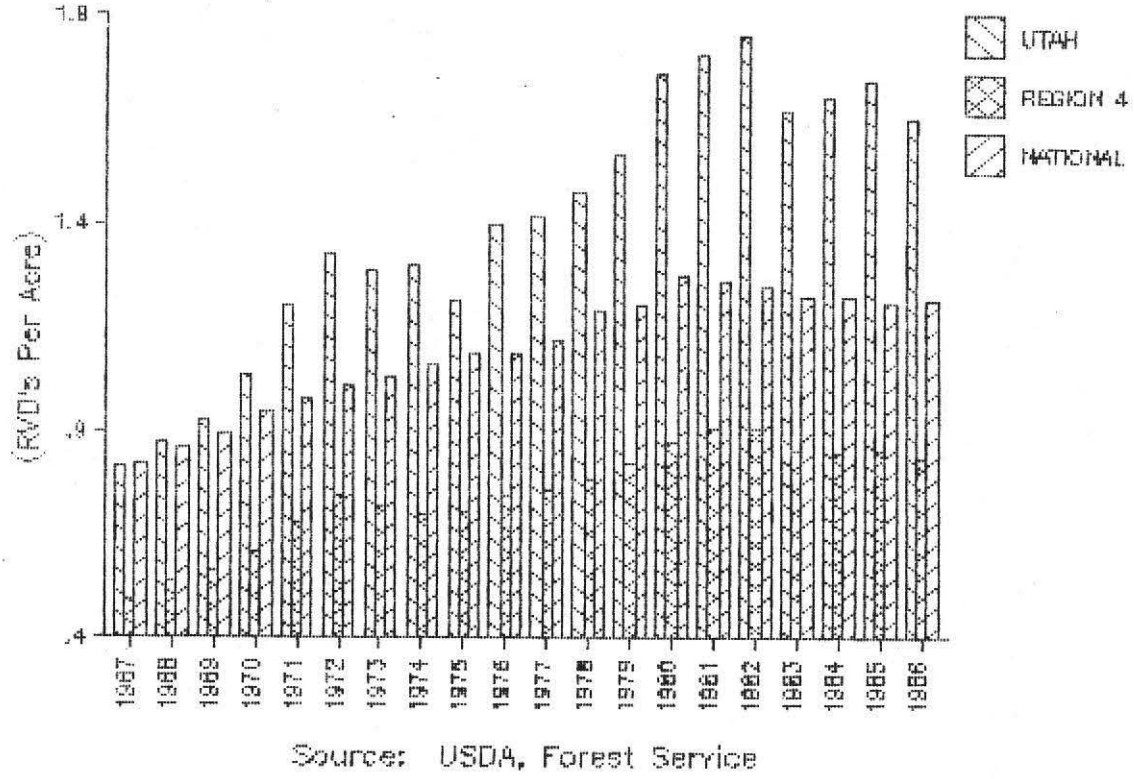

Figure 3. Total recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1986

Table 5. Growth Rate Comparisons and Regression Statistics of Total Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	3.833a	.0376107b (.007914)	.84718	.797216
Region 4	2.816a	.0277715b (.007296)	.80373	.889724
Nation	2.097a	.0207530b (.004642)	.86073	.941330

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

Table 6. USFS Non-Wilderness/Primitive RVD's and Acreage (Utah, Region 4, and Nation), 1967-1986

	UTAH			REGION 4			NATION		
YEAR	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	6,328.9	.82	7,696,756	14,475.4	.52	28,094,208	144,957.0	.86	167,683,122
1968	6,852.1	.89	7,707,361	16,064.8	.57	28,124,834	151,599.1	.90	167,717,197
1969	7,277.4	.94	7,730,680	16,878.8	.60	28,253,280	157,766.2	.94	167,709,961
1970	8,139.9	1.05	7,732,774	17,992.2	.64	28,228,455	166,711.7	.99	167,882,251
1971	9,499.5	1.23	7,734,690	20,236.5	.72	28,254,332	170,006.4	1.01	167,889,739
1972	10,488.4	1.35	7,749,904	22,326.3	.79	28,264,956	177,498.9	1.06	168,086,507
1973	10,178.9	1.31	7,758,188	21,622.0	.76	28,301,957	181,493.0	1.08	167,987,251
1974	10,282.5	1.33	7,754,297	21,112.5	.75	28,282,973	186,172.6	1.11	167,018,433
1975	9,605.9	1.24	7,754,761	21,038.2	.74	28,295,872	191,398.8	1.14	167,946,077
1976	11,000.9	1.42	7,752,859	22,377.6	.79	28,269,519	192,822.5	1.15	167,363,604
1977	11,108.0	1.43	7,753,762	22,646.7	.80	28,277,997	196,789.1	1.18	167,380,328
1978	11,547.2	1.49	7,724,163	23,468.2	.83	28,288,179	209,874.4	1.27	165,549,546
1979	12,226.8	1.58	7,723,954	24,306.5	.86	28,289,829	210,560.7	1.28	164,902,469
1980	13,758.5	1.78	7,723,647	26,286.9	.95	27,585,700	224,281.5	1.37	163,717,954
1981	14,099.9	1.83	7,723,564	27,067.3	.98	27,586,441	224,292.4	1.40	160,027,373
1982	14,502.0	1.88	7,723,732	27,086.3	.98	27,588,606	222,279.4	1.39	159,990,803
1983	13,124.9	1.70	7,722,924	25,536.3	.93	27,587,832	217,798.5	1.36	159,873,335
1984	13,328.3	1.78	7,499,645	25,315.6	.94	26,802,811	217,344.6	1.38	157,689,730
1985	13,495.3	1.87	7,211,072	25,216.3	.96	26,398,129	212,672.9	1.38	153,735,007
1986	12,699.8	1.76	7,209,560	24,690.8	.94	26,398,365	214,518.0	1.39	153,795,147

Source: USDA, Forest Service

lands from 1967 to 1986. RVD's in general terms ranged from 6,328.9 to 12,699.8 in Utah; 14,475.4 to 24,690.8 in Region 4; and 144,957.0 to 214,518.0 nationally through this twenty-year period (see figure 4 also). Percent growth rates estimated from this analysis were 3.791%, 2.829%, and 2.095%, respectively (see table 7).

Non-wilderness/primitive recreation use per acre at these same three levels ranged from .82 to 1.76 in Utah; .52 to .94 in Region 4; and .86 to 1.39 nationally (see table 6 and figure 5). Growth rates measured in this form were 4.111%, 3.137%, and 2.579%, respectively (see table 8).

As was demonstrated with total recreation, non-wilderness/primitive recreation use in both general terms and on a per acre basis had growth rates ranking highest in Utah, followed by Region 4, and lowest at the national level. Except for 1967 and 1968, however, RVD's per acre consistently ranked highest in Utah, followed by the nation, and lowest in Region 4 each year observed (see table 6 and figure 5).

Wilderness/Primitive Recreation Use (Utah, Region 4, and Nation)

USFS wilderness/primitive RVD's from 1967 to 1986 are presented in table 9. RVD's (1000's) in general terms ranged from 164.7 to 479.6 in Utah; 614.6 to 1,211.9 in Region 4; and 4,690.1 to 12,014.7 nationally (see figure 6 also). Percent compounded rates of growth estimated at these levels over the same twenty-year period were 7.079%, 3.961%, and 4.934%, respectively (see table 10).

Analyzing wilderness/primitive recreation use on a per acre basis at these same levels revealed a different pattern than that exhibited by

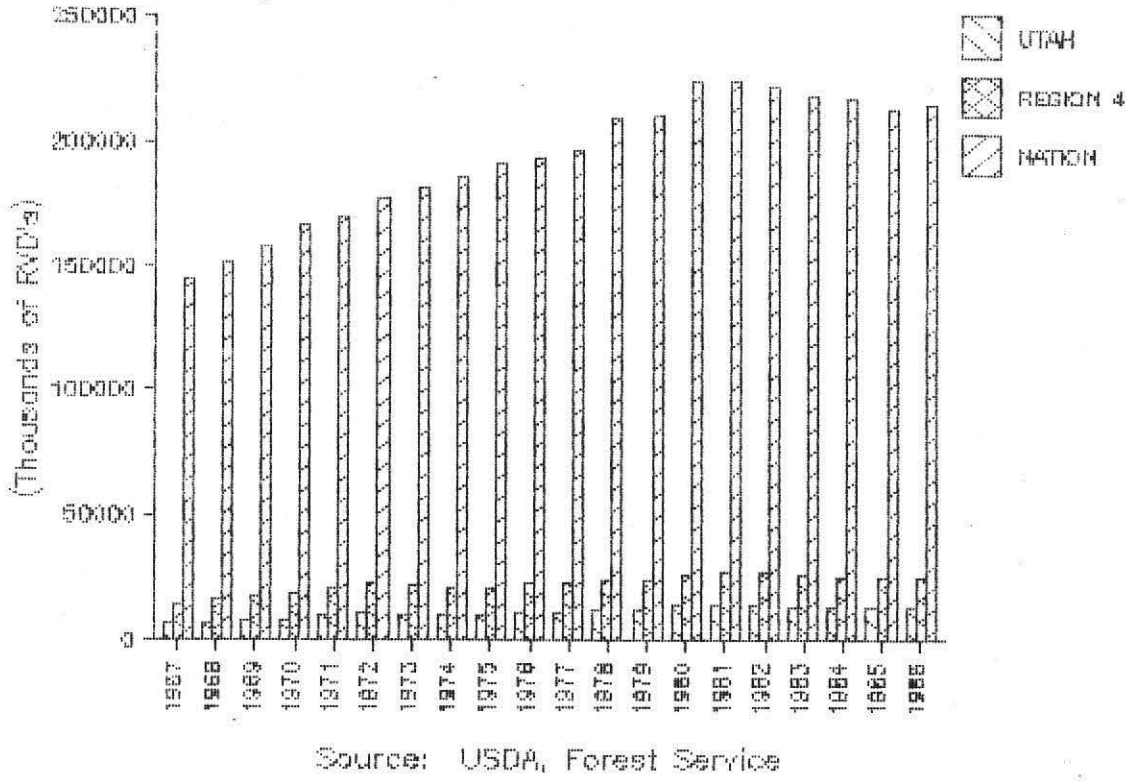

Figure 4. Non-wilderness/primitive recreation use on USFS lands in Utah, Region 4, and nation, 1967-1986

Table 7. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	3.791a	.0372086b (.008556)	.83158	.818173
Region 4	2.829a	.0278996b (.007737)	.78775	.898071
Nation	2.095a	.0207332b (.004593)	.86901	.934089

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

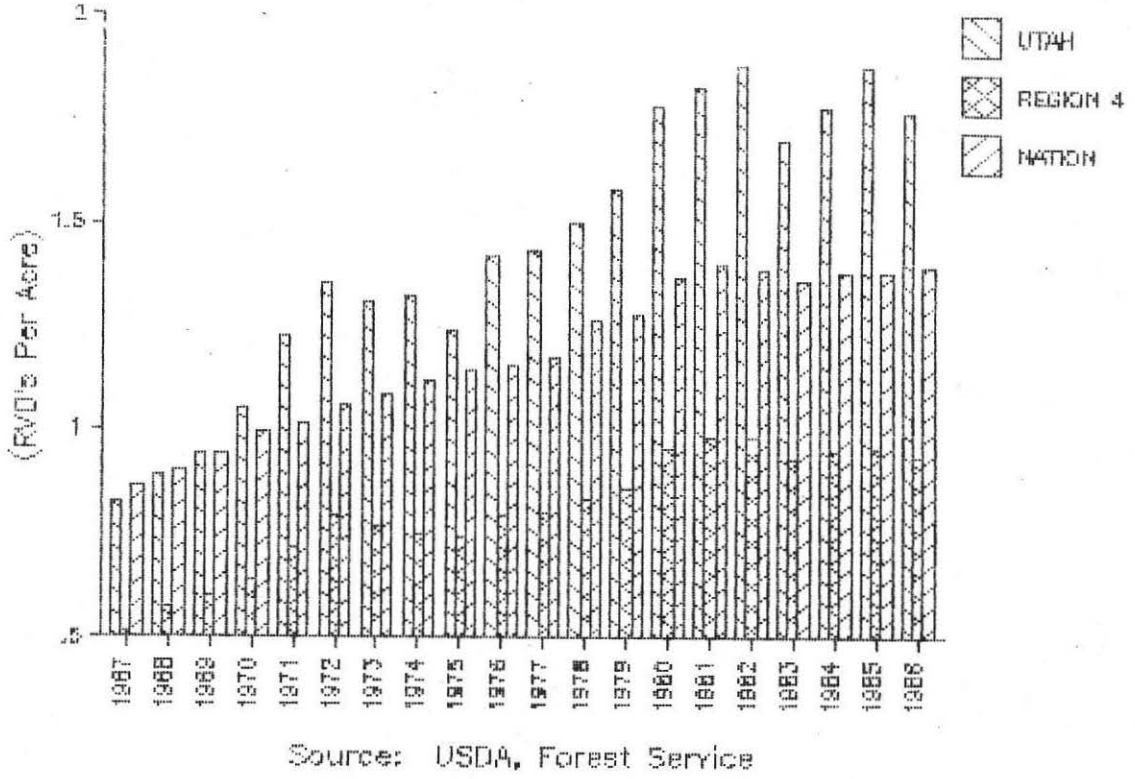

Figure 5. Non-wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and nation, 1967-1986

Table 8. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	4.111a	.0402894b (.006825)	.87667	.733637
Region 4	3.137a	.0308904b (.006176)	.85536	.821084
Nation	2.579a	.0254632b (.003315)	.94207	.852661

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

Table 9. USFS Wilderness/Primitive RVD's and Acreage (Utah, Region 4, and Nation), 1967-1986

YEAR	UTAH			REGION 4			NATION		
	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	164.7	.68	240,717	614.6	.23	2,724,967	4,690.1	.32	14,824,255
1968	101.8	.43	237,177	541.4	.20	2,721,427	5,056.2	.34	14,898,379
1969	111.6	.47	237,177	645.4	.24	2,721,427	5,071.9	.35	14,630,180
1970	124.4	.52	237,177	744.7	.27	2,721,427	5,842.8	.40	14,688,851
1971	104.5	.44	237,177	708.4	.26	2,721,427	8,103.6	.55	14,688,557
1972	119.7	.50	237,177	838.3	.31	2,739,539	6,459.4	.44	14,687,435
1973	135.3	.57	237,177	768.1	.28	2,739,539	6,681.7	.44	15,027,043
1974	129.2	.54	237,177	622.4	.23	2,739,539	6,743.2	.45	15,027,043
1975	131.9	.56	237,177	801.5	.29	2,739,539	7,802.0	.51	15,333,995
1976	150.1	.63	237,177	732.9	.27	2,764,723	7,105.6	.44	16,017,157
1977	234.0	.99	236,509	867.7	.31	2,764,055	8,008.3	.50	16,067,099
1978	233.0	.88	266,076	850.9	.30	2,793,622	8,619.9	.48	18,005,296
1979	274.3	1.03	266,597	1,149.6	.41	2,794,031	9,604.9	.53	18,284,424
1980	302.5	1.13	266,597	904.7	.26	3,499,287	9,267.8	.48	19,342,510
1981	317.6	1.19	266,597	1,156.1	.33	3,499,287	11,416.8	.43	26,414,229
1982	288.7	1.08	266,597	1,035.6	.30	3,499,287	11,158.1	.42	26,568,418
1983	205.5	.77	266,597	974.2	.28	3,499,287	9,909.3	.37	26,658,614
1984	292.8	.60	490,088	1,074.2	.25	4,285,104	10,209.3	.36	28,694,072
1985	419.0	.54	779,638	1,388.3	.30	4,702,079	12,734.4	.39	32,580,492
1986	479.6	.62	778,001	1,211.9	.26	4,707,365	12,014.7	.37	32,667,857

Source: USDA, Forest Service

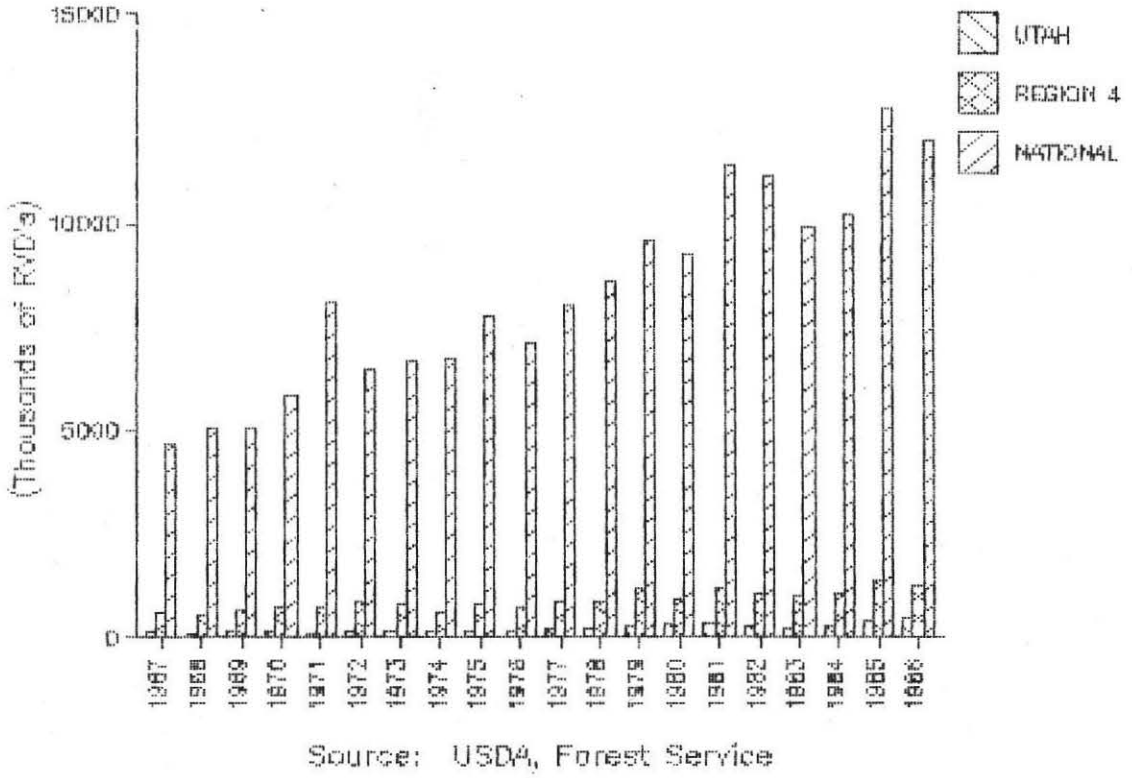

Figure 6. Wilderness/primitive recreation use on USFS lands in Utah, Region 4, and **nation,** 1967-1986

Table 10. Growth Rate Comparisons and Regression Statistics of Wilderness/Primitive Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\overline{R}^2$	ρ
Utah	7.079a	.0683954b (.014300)	.78249	.524378
Region 4	3.961	.0388500b (.004409)	.80134	-.170360c
Nation	4.934	.0481637b (.003726)	.89734	.059145c

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.
c/ Estimated

the other forms of recreation use previously described. In this case, RVD's per acre ranged from .68 to .62 in Utah; .23 to .26 in Region 4; and .32 to .37 nationally (see table 9 and figure 7), with estimated growth rates of .858%, 1.140%, and .494%, respectively (see table 11).

These statistics indicate that wilderness/primitive recreation use growth rates in general terms ranked highest in Utah, followed by the nation, and lowest in Region 4. In contrast, however, growth rate comparisons measured on a per acre basis appeared to be highest in Region 4, followed by Utah, and then the nation. The variation exhibited at all three levels over twenty years with this form of recreation use on a per acre basis was extreme enough that it kept growth rate estimates from being statistically significant (see table 11).

With the exception of 1971, wilderness/primitive RVD's per acre followed the same consistent trend set by the other forms of recreation use where Utah ranked highest, followed by the nation, and then lowest in Region 4 each year observed (see table 9 and figure 7).

Chow Test

Utah, Region 4, and Nation

A general overview of non-wilderness/primitive and wilderness/primitive recreation use patterns at Utah, Region 4, and national levels indicated that peak uses generally occurred during the 1979-1981 period. One exception applies here, however; in general terms, wilderness/primitive recreation use exhibited an upward growth trend until it peaked in 1985 (see figure 6). This stands to reason because USFS wilderness/primitive acreage has increased much more

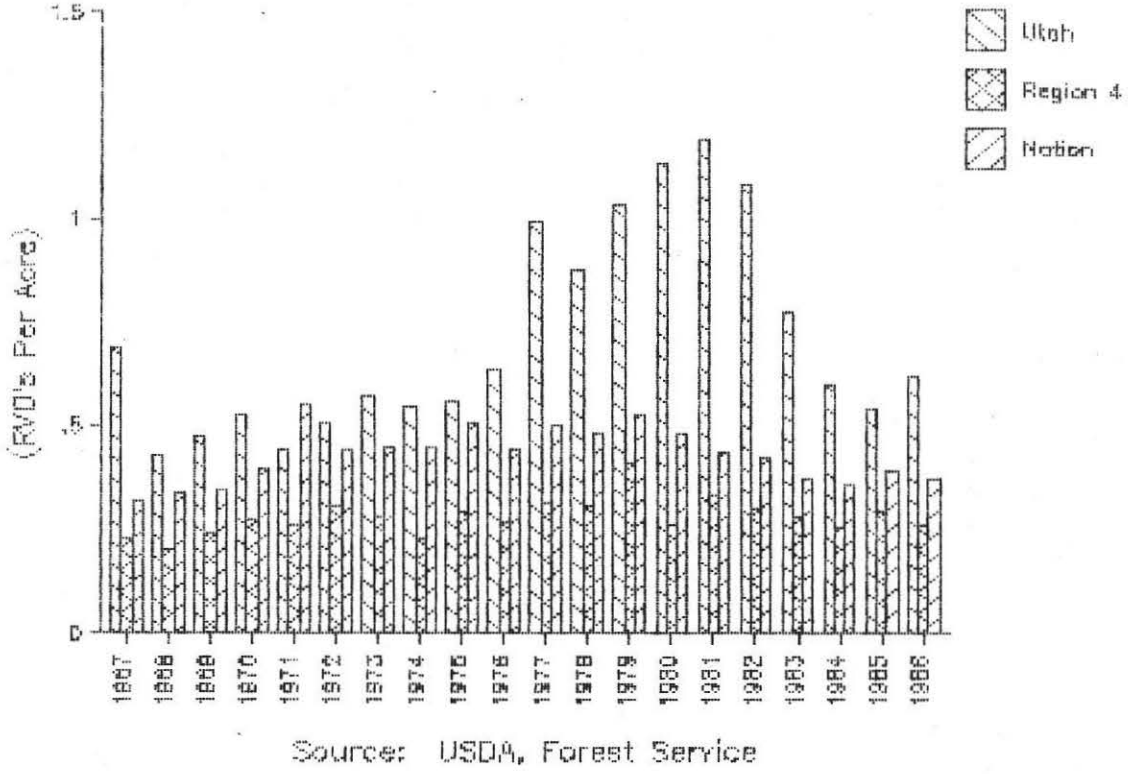

Figure 7. Wilderness/primitive recreation use per acre on USFS lands in Utah, Region 4, and **nation,** 1967-1986

Table 11. Growth Rate Comparisons and Regression Statistics of Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	.858a	.0085458 (.022540)	.21760	.779879
Region 4	1.140	.0113347 (.005696)	.13478	.112800c
Nation	.494a	.0049270 (.011750)	-.04864	.714660

a/ Adjusted for positive autocorrelation.
c/ Estimated

dramatically over time relative to USFS non-wilderness areas.

Post 1980 recreation use, in both general terms and on a per acre basis, generally showed stable to only slightly moderate downward trends (see table 3, table 6, table 9, figure 2, figure 3, figure 4, figure 5, figure 6, and figure 7). Wilderness/primitive recreation use per acre post 1980, however, exhibited a very pronounced downward trend (see figure 7). Moreover, examination of figure 6 suggested that wilderness/primitive recreation use had an abrupt change in its general consistent pattern of upward growth following 1976. It was these observations that prompted application of the Chow test so as to measure significant differences in growth rates of two ten-year periods--1967-1976, and 1977-1986.

Non-Wilderness/Primitive Recreation Use

The Chow test was applied to non-wilderness/primitive recreation use in both general terms and on a per acre basis at Utah, Region 4 and national levels. Analysis of non-wilderness/primitive recreation revealed statistically significant differences between all growth rates estimated for each of the two ten-year periods. Specifically, growth rate estimates for the 1967-1976 and 1977-1986 periods in general terms were, respectively, 6.252% and 1.532 in Utah; 4.877% and 0.943% in Region 4; and 3.243% and 0.829% nationally (see table 12 and table 13). Non-wilderness/primitive recreation use growth rate estimates measured on a per acre basis for the two ten-year periods were, respectively, 6.164% and 2.360% in Utah; 4.801% and 1.724% in Region 4; and 3.262% and 1.770% nationally (see table 14 and table 15). These statistics suggest that not only was there a significant difference between the two

Table 12. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1967-1976

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	6.252a	.0606440b (.013380)	.80982	.625092
Region 4	4.877a	.0476148b (.011390)	.79453	.712370
Nation	3.243a	.0319115b (.002960)	.97088	.680537

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

Table 13. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1977-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	1.532a	.0152013 (.012720)	.22389	.700272
Region 4	0.943a	.0093838 (.009319)	.09406	.801111
Nation	0.829a	.0082568 (.006490)	.08677	.698648

a/ Adjusted for positive autocorrelation.

Table 14. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1967-1976

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	6.164a	.0598152b (.013230)	.80815	.618093
Region 4	4.801a	.0468914b (.011190)	.79377	.702501
Nation	3.262a	.0320970b (.002811)	.97410	.687089

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

Table 15. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1977-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	2.360a	.0233301b (.010200)	.51891	.529358
Region 4	1.724a	.0170904 (.008829)	.44050	.695948
Nation	1.770a	.0175471b (.006298)	.58872	.667002

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

ten-year periods, but also that growth rates increased at a less rapid rate from 1977-1986 in contrast to 1967-1976.

Wilderness/Primitive Recreation Use

As with non-wilderness/primitive recreation use, the Chow test was applied to wilderness/primitive recreation use in both general terms and on a per acre basis. Growth rates from each of the two ten-year periods were significantly different at all levels except at Region 4 and national levels when measured in general terms. Specifically, growth rate estimates for the 1967-1976 and 1977-1986 periods in general terms were, respectively, 1.279% and 6.802% in Utah; 2.709% and 3.833% in Region 4; and 5.206% and 4.249% nationally (see table 16 and table 17). These statistics imply that growth rates increased at more rapid rates from 1977-1986 in contrast to 1967-1976 in Utah and Region 4. Nationally, however, increases in such recreation use occurred at a less rapid rate when contrasting the two ten-year periods measured in general terms.

Growth rate estimates of wilderness/primitive recreation use measured on a per acre basis revealed marked differences in growth rates at all levels between the two ten-year time periods. Growth rates in this perspective were negative at all levels examined from 1977-1986 in contrast to positive rates of growth exhibited from 1967-1976. Specifically, growth rates of wilderness/primitive recreation use per acre from 1967-1976 and 1977-1986 were, respectively, 1.361% and -5.775% in Utah; 2.562% and -2.613% in Region 4; and 4.508% and -4.092% nationally (see table 18 and table 19).

Although all values reported thus far have been outlined with

Table 16. Growth Rate Comparisons and Regression Statistics of Wilderness/Primitive Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1967-1976

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	1.279	.0127133 (.017175)	-.05289	.131000c
Region 4	2.709	.0267255 (.012890)	.26836	.000199c
Nation	5.206	.0507515b (.012760)	.62224	.086055c

b/ Significant at .05 level.
c/ Estimated

Table 17. Growth Rate Comparisons and Regression Statistics of Wilderness/Primitive Recreation Use on USFS Lands in Utah, Region 4, and Nation, 1977-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	6.802a	.0658026 (.029590)	.39305	.436752
Region 4	3.833	.0376109b (.012820)	.45823	-.410020c
Nation	4.249	.0416163b (.009084)	.68954	-.023029c

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.
c/ Estimated

Table 18. Growth Rate Comparisons and Regression Statistics of Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1967-1976

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	1.361	.0135197 (.016750)	-.04030	.124560c
Region 4	2.562	.0252962 (.012940)	.23866	.009585c
Nation	4.508	.0440890b (.013970)	.49906	.203180c

b/ Significant at .05 level.
c/ Estimated

Table 19. Growth Rate Comparisons and Regression Statistics of Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, Region 4, and Nation, 1977-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Utah	-5.775a	-.0594846 (.032700)	.48072	.663556
Region 4	-2.613	-.0264750 (.014360)	.21047	.600290c
Nation	-4.092	-.0417808b (.006980)	.79468	.225380c

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.
c/ Estimated

respect to each form of recreation use, they will also be presented with respect to each level examined (Utah, Region 4, and national) so as to offer additional perspectives. The following three sections in this chapter are selectively intended to accomplish this. To avoid redundancy, they will only be generally addressed rather than discussed in specific detail as was done in previous sections.

National Recreation Use (Non-Wilderness/Primitive and Wilderness/Primitive)

Table 20 outlines national USFS recreation use with respect to non-wilderness/primitive and wilderness/primitive RVD's from 1967 to 1986. Figure 8 offers a visual perspective of RVD's (1000's) in general terms outlined in table 20. Non-wilderness/primitive RVD's were shown to exceed wilderness/primitive RVD's, as intuitively expected. Growth rates of these two forms of recreation use measured in general terms over this same twenty-year period ranked just the opposite, however. Non-wilderness/primitive recreation use increased at a rate of 2.095%, whereas wilderness/primitive recreation use increased at a rate of 4.934% (see table 21).

Figure 9 presents another visual perspective, and perhaps a more appropriate relative comparison of non-wilderness/primitive and wilderness/primitive recreation use for 1967 to 1986 at the national level--use on a per acre basis. National RVD's per acre proved to be consistently higher in the form of non-wilderness/primitive recreation use relative to wilderness/primitive recreation use each year observed (see table 20 also). Estimated growth rates measured on a per acre basis were 2.575% and .494%, respectively (see table 22). In other

Table 20. USFS RVD's in Nation and Acreage (Wilderness/Primitive and Non-Wilderness/Primitive), 1967-1986

	WILDERNESS/PRIMITIVE			NON-WILDERNESS/PRIMITIVE		
YEAR	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	4,690.1	.32	14,824,255	144,957.0	.86	167,683,122
1968	5,056.2	.34	14,898,379	151,599.1	.90	167,717,197
1969	5,071.9	.35	14,630,180	157,766.2	.94	167,709,961
1970	5,842.8	.40	14,688,851	166,711.7	.99	167,882,251
1971	8,103.6	.55	14,688,557	170,006.4	1.01	167,889,739
1972	6,459.4	.44	14,687,435	177,498.9	1.06	168,086,507
1973	6,681.7	.44	15,027,043	181,493.0	1.08	167,987,251
1974	6,743.2	.45	15,027,043	186,172.6	1.11	167,018,433
1975	7,802.0	.51	15,333,995	191,398.8	1.14	167,946,077
1976	7,105.6	.44	16,017,157	192,822.5	1.15	167,363,604
1977	8,008.3	.50	16,067,099	196,789.1	1.18	167,380,328
1978	8,619.9	.48	18,005,296	209,874.4	1.27	165,549,546
1979	9,604.9	.53	18,284,424	210,560.7	1.28	164,902,469
1980	9,267.8	.48	19,342,510	224,281.5	1.37	163,717,954
1981	11,416.8	.43	26,414,229	224,292.4	1.40	160,027,373
1982	11,158.1	.42	26,568,418	222,279.4	1.39	159,990,803
1983	9,909.3	.37	26,658,614	217,798.5	1.36	159,873,335
1984	10,209.3	.36	28,694,072	217,344.6	1.38	157,689,730
1985	12,734.4	.39	32,580,492	212,672.9	1.38	153,735,007
1986	12,014.7	.37	32,667,857	214,518.0	1.39	153,795,147

Source: USDA, Forest Service

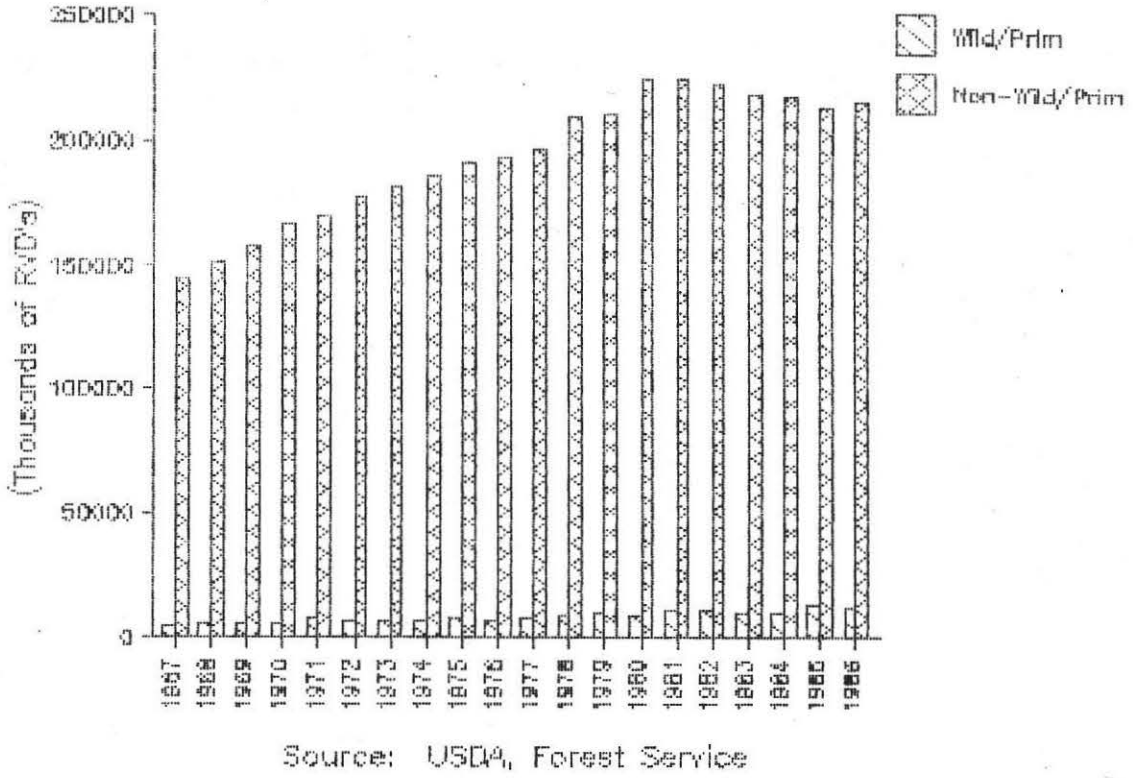

Figure 8. Non-wilderness/primitive and wilderness/primitive recreation use on USFS lands in **nation,** 1967-1986

Table 21. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive and Wilderness/Primitive Recreation Use on USFS Lands in Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Non-Wild/Prim	2.095a	.0207332b (.004593)	.86901	.934089
Wild/Prim	4.934	.0481637b (.003726)	.89734	.059145c

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.
c/ Estimated

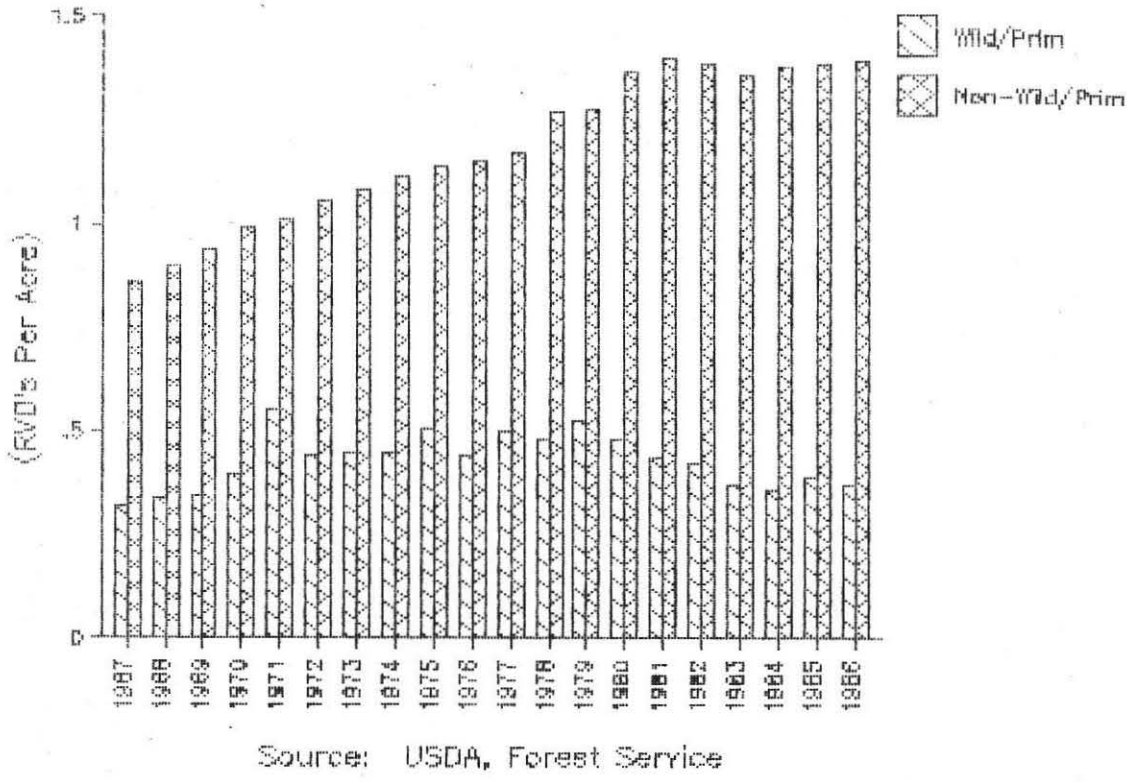

Figure 9. Non-wilderness/primitive and wilderness/primitive recreation use per acre on USFS lands in **nation,** 1967-1986

Table 22. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive and Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Nation, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Non-Wild/Prim	2.579a	.0254632b (.003315)	.94207	.852661
Wild/Prim	.494a	.0049270 (.011750)	-.04864	.714660

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

words, these statistics suggest that non-wilderness/primitive recreation use increased at a more rapid rate than did wilderness/primitive recreation use when observed on a per acre basis over the twenty-year period. The reverse was true when observed in general terms.

Region 4 Recreation Use (Non-Wilderness/Primitive and Wilderness/Primitive)

Non-wilderness/primitive and wilderness/primitive RVD's in Region 4 are displayed in table 23. A visual description of these two forms of recreation use in general terms is also displayed in figure 10 where non-wilderness/primitive RVD's are consistently shown to be greater than wilderness/primitive RVD's, as one would expect. Estimated growth rates for non-wilderness/primitive and wilderness/primitive recreation uses in general terms were 2.829% and 3.961%, respectively (see table 24).

Calculations of RVD's in Region 4 on a per acre basis from 1967 to 1986 are shown in table 23, as well as graphically in figure 11. Non-wilderness/primitive RVD's per acre were consistently higher than wilderness/primitive RVD's per acre throughout the twenty-year period. Growth rate estimates measured on a per acre basis over this same twenty-year period were 3.137% for non-wilderness/primitive recreation use and 1.140% for wilderness/primitive recreation use (see table 25).

These statistics suggest that Region 4 non-wilderness/primitive recreation use exceeded wilderness/primitive recreation use in both general terms and on a per acre basis. In general terms, wilderness/primitive recreation use increased at a more rapid rate than did non-wilderness/primitive recreation use from 1967 to 1986. Growth rates estimated on a per acre basis, however, revealed that

Table 23. USFS RVD's in Region 4 and Acreage (Wilderness/Primitive and Non-Wilderness/Primitive), 1967-1986

	WILDERNESS/PRIMITIVE			NON-WILDERNESS/PRIMITIVE		
YEAR	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	614.6	.23	2,724,967	14,475.4	.52	28,094,208
1968	541.4	.20	2,721,427	16,064.8	.57	28,124,834
1969	645.4	.24	2,721,427	16,878.8	.60	28,253,280
1970	744.7	.27	2,721,427	17,992.2	.64	28,228,455
1971	708.4	.26	2,721,427	20,236.5	.72	28,254,332
1972	838.3	.31	2,739,539	22,326.3	.79	28,264,956
1973	768.1	.28	2,739,539	21,622.0	.76	28,301,957
1974	622.4	.23	2,739,539	21,112.5	.75	28,282,973
1975	801.5	.29	2,739,539	21,038.2	.74	28,295,872
1976	732.9	.27	2,764,723	22,377.6	.79	28,269,519
1977	867.7	.31	2,764,055	22,646.7	.80	28,277,997
1978	850.9	.30	2,793,622	23,468.2	.83	28,288,179
1979	1,149.6	.41	2,794,031	24,306.5	.86	28,289,829
1980	904.7	.26	3,499,287	26,286.9	.95	27,585,700
1981	1,156.1	.33	3,499,287	27,067.3	.98	27,586,441
1982	1,035.6	.30	3,499,287	27,086.3	.98	27,588,606
1983	974.2	.28	3,499,287	25,536.3	.93	27,587,832
1984	1,074.2	.25	4,285,104	25,315.6	.94	26,802,811
1985	1,388.3	.30	4,702,079	25,216.3	.96	26,398,129
1986	1,211.9	.26	4,707,365	24,690.8	.94	26,398,365

Source: USDA, Forest Service

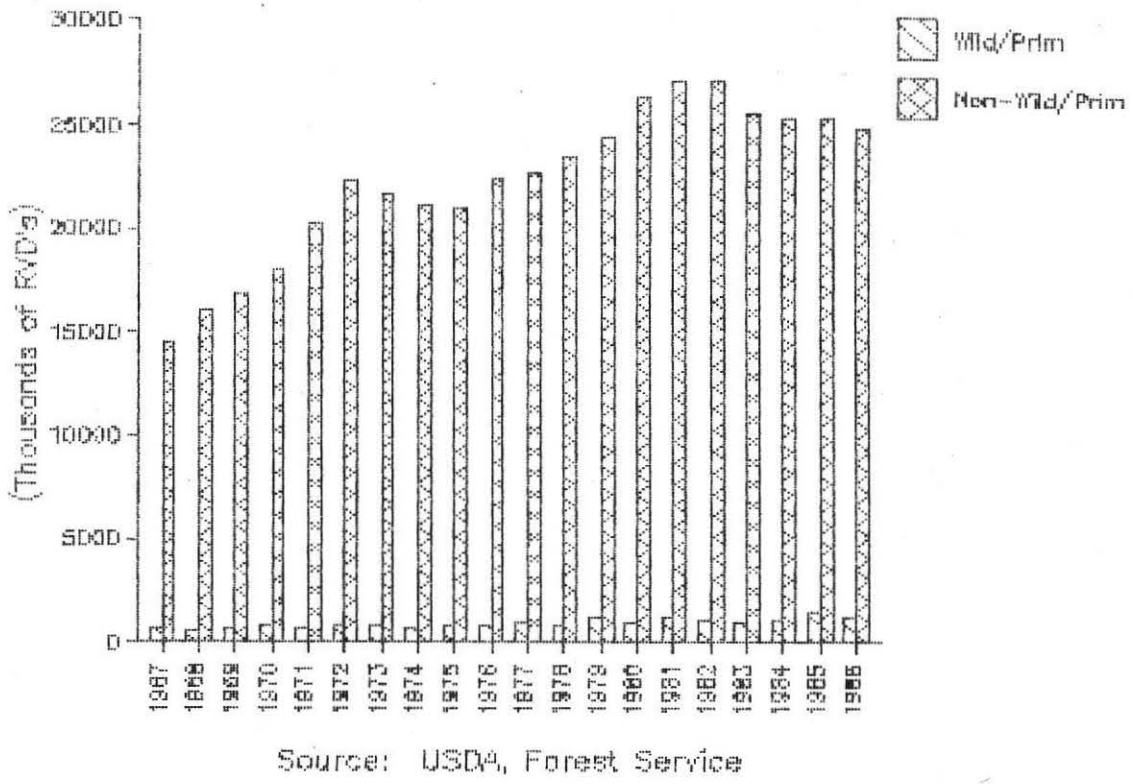

Figure 10. Non-wilderness/primitive and wilderness/primitive recreation use on USFS lands in Region 4, 1967-1986

Table 24. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive and Wilderness/Primitive Recreation Use on USFS Lands in Region 4, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\overline{R}^2$	ρ
Non-Wild/Prim	2.829a	.0278996b (.007737)	.78775	.898071
Wild/Prim	3.961	.0388500b (.004409)	.80134	-.17036c

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.
c/ Estimated

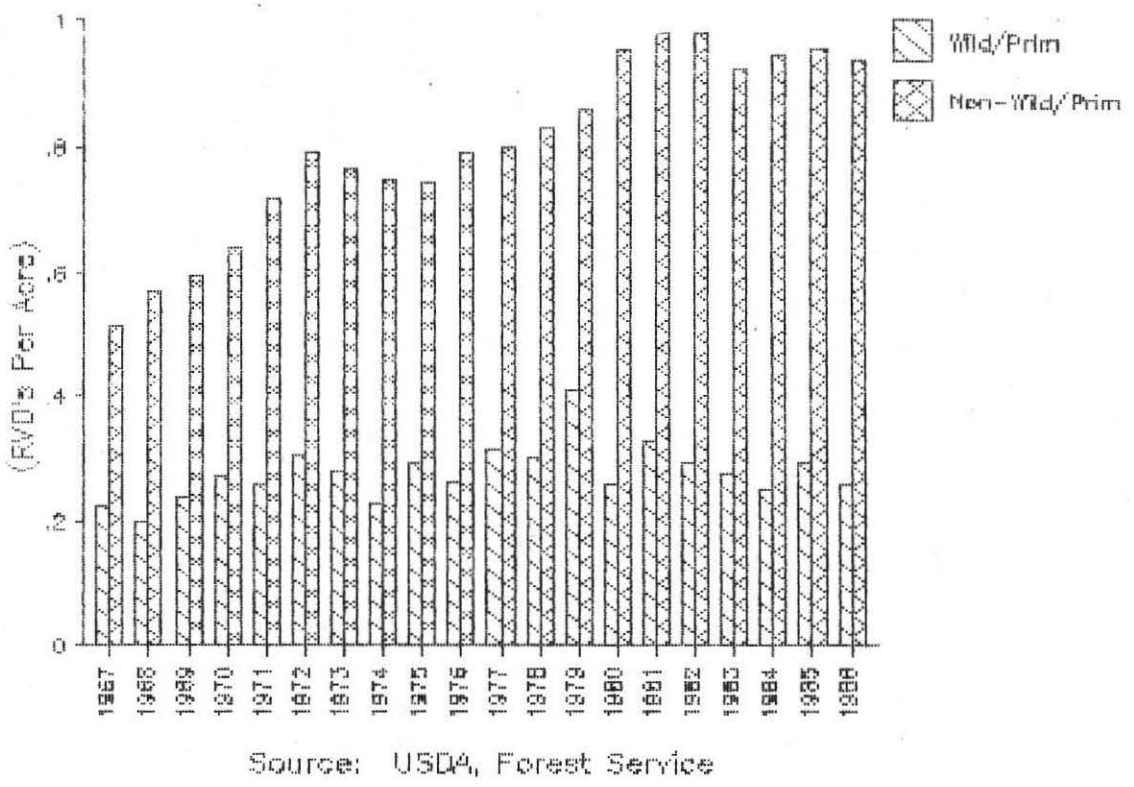

Figure 11. Non-wilderness/primitive and wilderness/primitive recreation use per acre on USFS lands in Region 4, 1967-1986

Table 25. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive and Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Region 4, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Non-Wild/Prim	3.137a	.0308904b (.006756)	.85536	.821084
Wild/Prim	1.140	.0113347 (.005696)	.13478	.11280c

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.
c/ Estimated

non-wilderness/primitive recreation use increased at a more rapid rate than did wilderness/primitive recreation use.

Utah Recreation Use (Non-Wilderness/Primitive and Wilderness/Primitive)

Table 26 outlines Utah USFS recreation use with respect to non-wilderness/primitive and wilderness/primitive RVD's from 1967 to 1986. Figure 12 presents a visual perspective of RVD's (1000's) in general terms outlined in table 20. As was the case nationally and in Region 4, Utah non-wilderness/primitive recreation use consistently exceeded wilderness/primitive recreation use. Estimated growth rates over the same twenty-year period for non-wilderness/primitive recreation use and wilderness/primitive recreation use in general terms were 3.791% and 7.079%, respectively (see table 27).

RVD's presented on a per acre basis from 1967 to 1986 are shown in table 26 and graphically in figure 13. Non-wilderness/primitive recreation use was consistently higher than wilderness/recreation use over the twenty-year period in this respect. Estimated growth rates measured on a per acre basis were 4.111% for non-wilderness/primitive recreation use and .858% for wilderness/primitive recreation use (see table 28). These estimates suggest that non-wilderness/primitive recreation use increased at a more rapid rate than did wilderness/primitive recreation use, which contradicts growth rate implications estimated in general terms.

The general implications derived from the results presented in the previous discussions under national, Region 4, and Utah non-wilderness/primitive and wilderness/primitive recreation use

Table 26. USFS RVD's in Utah and Acreage (Wilderness/Primitive and Non-Wilderness/Primitive), 1967-1986

	WILDERNESS/PRIMITIVE			NON-WILDERNESS/PRIMITIVE		
YEAR	RVD's (1000's)	RVD's PER ACRE	ACREAGE	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	164.7	.68	240,717	6,328.9	.82	7,696,756
1968	101.8	.43	237,177	6,852.1	.89	7,707,361
1969	111.6	.47	237,177	7,277.4	.94	7,730,680
1970	124.4	.52	237,177	8,139.9	1.05	7,732,774
1971	104.5	.44	237,177	9,499.5	1.23	7,734,690
1972	119.7	.50	237,177	10,488.4	1.35	7,749,904
1973	135.3	.57	237,177	10,178.9	1.31	7,758,188
1974	129.2	.54	237,177	10,282.5	1.33	7,754,297
1975	131.9	.56	237,177	9,605.9	1.24	7,754,761
1976	150.1	.63	237,177	11,000.9	1.42	7,752,859
1977	234.0	.99	236,509	11,108.0	1.43	7,753,762
1978	233.0	.88	266,076	11,547.2	1.49	7,724,163
1979	274.3	1.03	266,597	12,226.8	1.58	7,723,954
1980	302.5	1.13	266,597	13,758.5	1.78	7,723,647
1981	317.6	1.19	266,597	14,099.9	1.83	7,723,564
1982	288.7	1.08	266,597	14,502.0	1.88	7,723,732
1983	205.5	.77	266,597	13,124.9	1.70	7,722,924
1984	292.8	.60	490,088	13,328.3	1.78	7,499,645
1985	419.0	.54	779,638	13,495.3	1.87	7,211,072
1986	479.6	.62	778,001	12,699.8	1.76	7,209,560

Source: USDA, Forest Service

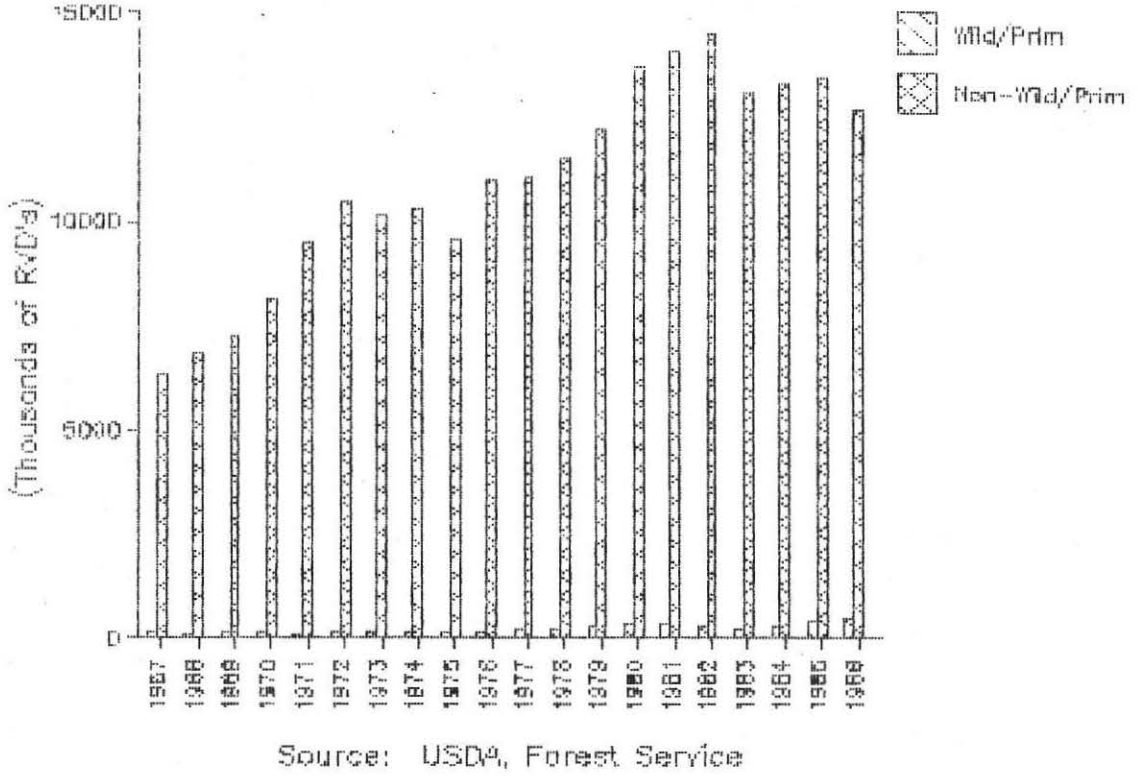

Figure 12. Non-wilderness/primitive and wilderness/primitive recreation use on USFS lands in Utah, 1967-1986

Table 27. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive and Wilderness/Primitive Recreation Use on USFS Lands in Utah, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Non-Wild/Prim	3.791a	.0372086b (.008556)	.83158	.818173
Wild/Prim	7.079a	.0683954b (.014300)	.78249	.524378

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

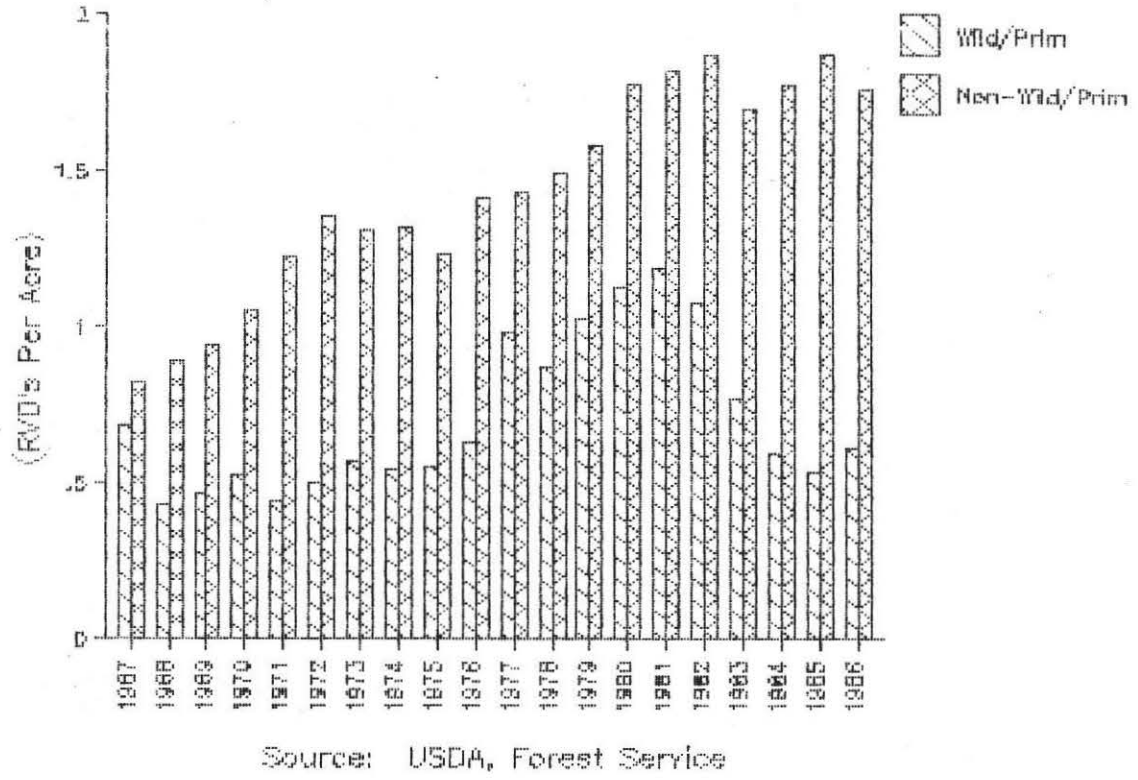

Figure 13. Non-wilderness/primitive and wilderness/primitive recreation use per acre on USFS lands in Utah, 1967-1986

Table 28. Growth Rate Comparisons and Regression Statistics of Non-Wilderness/Primitive and Wilderness/Primitive Recreation Use Per Acre on USFS Lands in Utah, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
Non-Wild/Prim	4.111a	.0402894b (.006825)	.87667	.733637
Wild/Prim	.858a	.0085458 (.022540)	.21760	.779879

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

headings are basically very consistent. Despite differences in specific values relating to various growth rates, non-wilderness/primitive recreation use was found to be increasing more rapidly than wilderness/primitive recreation use when evaluated on a per acre basis. This contradicted observations implied from growth rate estimates in general terms.

High Uintas Wilderness/Primitive Area Recreation Use

General Recreation Use

The High Uintas has historically served as one of Utah's most sought-after outdoor recreation areas. It was designated as a primitive area in the early 1930's and was managed as such until it was classified as a wilderness area in 1984. Because of the popularity of the High Uintas and for an added perspective of the dynamics of USFS wilderness/primitive recreation use in Utah, this specific area was also evaluated.

Table 29 presents recreational use of the USFS High Uintas Wilderness/Primitive Area from 1967-1986. In general terms, recreation use changed from 164.7 to 296.1 RVD's (1,000's) during this period (see figure 14 also for a visual description). The growth rate estimated through this period with respect to these figures was 4.935% (see table 30).

Chow Test

Analysis of figure 14 suggested that a marked shift in recreation use occurred in the High Uintas Wilderness/Primitive Area beginning in 1977, similar to previously described levels. Therefore, the Chow test was applied to determine whether or not there was a statistically

Table 29. USFS High Uintas RVD's and Acreage, 1967-1986

YEAR	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1967	164.7	.68	240,717
1968	101.8	.43	237,177
1969	111.6	.47	237,177
1970	124.4	.52	237,177
1971	104.5	.44	237,177
1972	119.7	.50	237,177
1973	135.3	.57	237,177
1974	129.2	.54	237,177
1975	131.9	.56	237,177
1976	150.1	.63	237,177
1977	234.0	.99	236,509
1978	218.0	.92	236,509
1979	235.2	.99	236,509
1980	247.0	1.04	236,509
1981	271.2	1.15	236,509
1982	245.5	1.04	236,509
1983	180.2	.76	236,509
1984	241.1	.52	460,000
1985	257.7	.56	460,000
1986	296.1	.64	460,000

Source: USDA, Forest Service

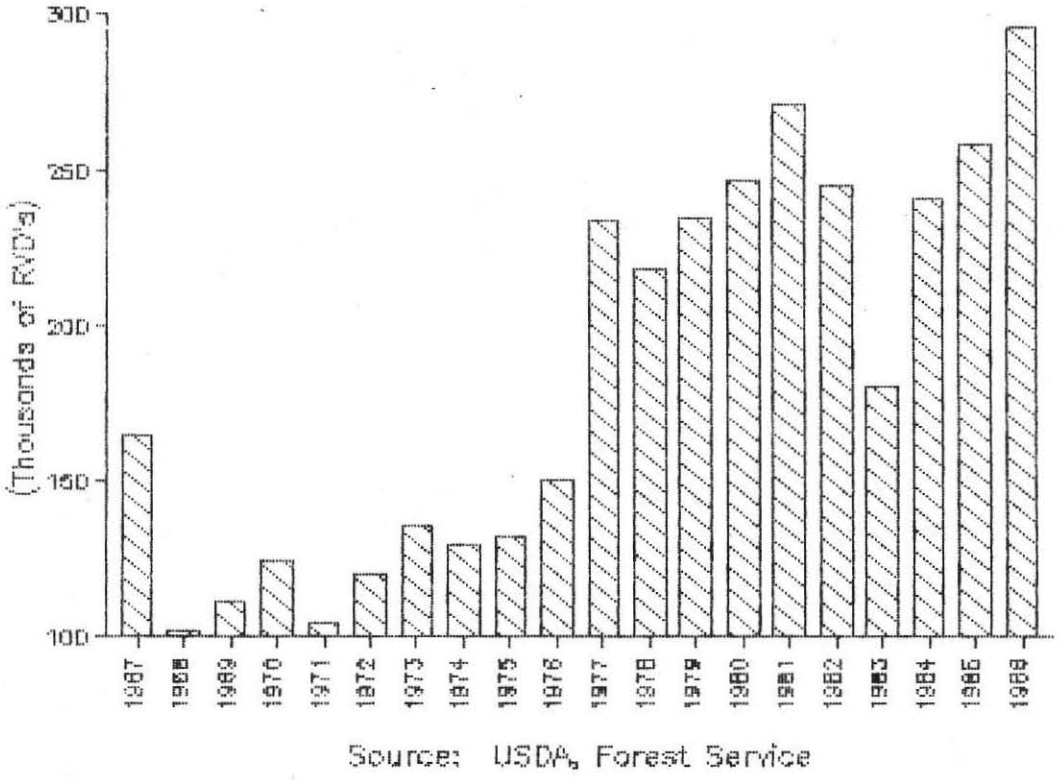

Figure 14. Recreation use on USFS High Uintas Wilderness/Primitive Area, 1967-1986

Table 30. Growth Rate and Regression Statistics of Recreation Use on USFS High Uintas Wilderness/Primitive Area, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
1967-1986	4.935a	.0481729b (.010930)	.71656	.426639

a/ Adjusted for positive autocorrelation.
b/ Significant at .05 level.

significant difference in the two growth rates from 1967 to 1976 and 1977 to 1986. Growth rates for these two periods were 1.280% and 1.445%, respectively, and were significantly different from one another (see table 31 and table 32).

Recreation Use Per Acre

Recreation use calculated on a per acre basis in the High Uintas Wilderness/Primitive Area is described in both table 29 and figure 15. Recreation use in this respect changed from .68 to .64 RVD's per acre from 1967 to 1986 with a high of 1.15 RVD's per acre in 1981. The growth rate during this twenty-year interval was 1.085% (see table 33). Due to the extreme variation exhibited by annual RVD's per acre, however, this estimate was not statistically significant.

Chow Test

Visual observation of figure 15 suggested a marked difference in the general pattern of recreation use per acre beginning in 1977, with a positive rate of growth from 1967 to 1976 and a negative rate of growth from 1977 to 1986 (similar to other levels of wilderness/primitive recreation use per acre previously examined). Application of the Chow test revealed statistically significant differences between the two ten-year periods with growth rates of 1.365% from 1967-1976 and -5.715% from 1977-1986 (see table 34 and table 35).

Net Utah Wilderness/Primitive Recreation Use (High Uintas Excluded)

Up until 1978, there were no formally designated wilderness/primitive areas in Utah other than the High Uintas. Since

Table 31. Growth Rate and Regression Statistics of Recreation Use on USFS High Uintas Wilderness/Primitive Area, 1967-1976

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
1967-1976	1.280	.0127140 (.017180)	-.05293	.131030c

c/ Estimated

Table 32. Growth Rate and Regression Statistics of Recreation Use on USFS High Uintas Wilderness/Primitive Area, 1977-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
1977-1986	1.445	.0143506 (.014610)	-.00388	.179630c

c/ Estimated

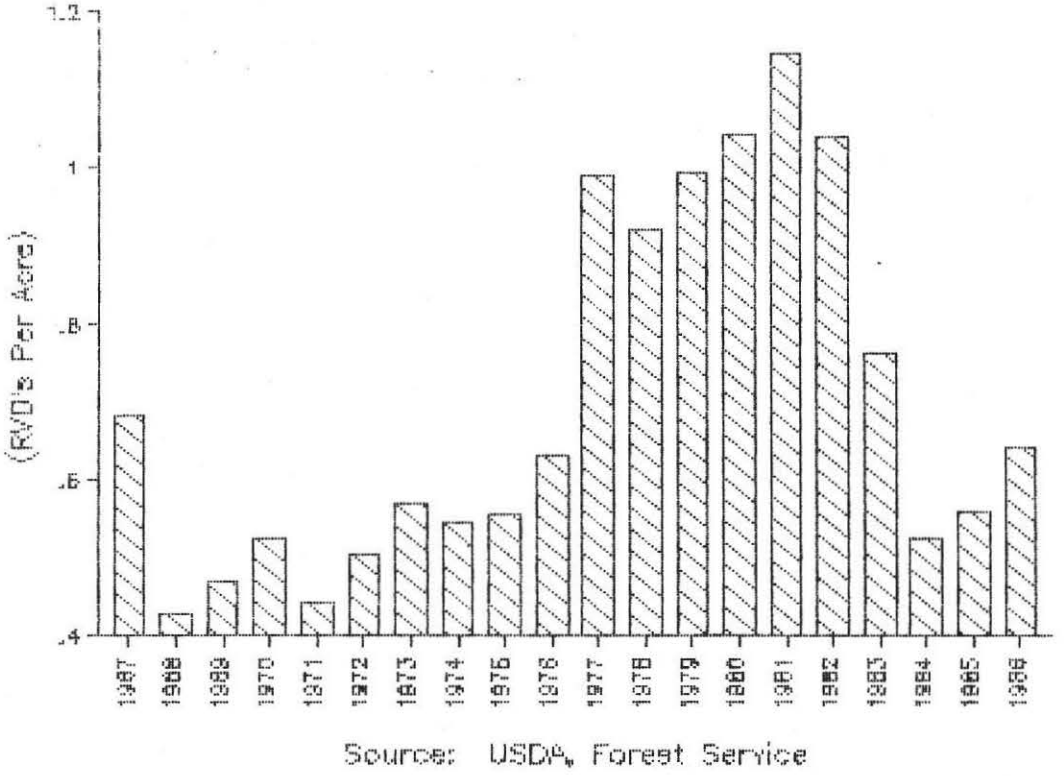

Figure 15. Recreation use per acre on USFS High Uintas Wilderness/ Primitive Area, 1967-1986

Table 33. Growth Rate and Regression Statistics of Recreation Use Per Acre on USFS High Uintas Wilderness/Primitive Area, 1967-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
1967-1986	1.085a	.0107900 (.021110)	.20710	.750454

a/ Adjusted for positive autocorrelation.

Table 34. Growth Rate and Regression Statistics of Recreation Use Per Acre on USFS High Uintas Wilderness/Primitive Area, 1967-1976

	% Compounded Rate of Growth	$\hat{\beta}$	$\overline{R}^2$	ρ
1967-1976	1.361	.0135220 (.016760)	-.04033	.124560c

c/ Estimated

Table 35. Growth Rate and Regression Statistics of Recreation Use Per Acre on USFS High Uintas Wilderness/Primitive Area, 1977-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\overline{R}^2$	ρ
1977-1986	-5.715a	-.0588501 (.030190)	.51293	.579654

a/ Adjusted for positive auto correlation

that time, 12 other USFS areas have been formally classified as wilderness, comprising a total of 318,001 acres. Recreation use with respect to these wilderness areas combined, from 1978 to 1986, is outlined in table 36. A visual description of recreation use in general terms during this period is offered in figure 16, with RVD's (1000's) ranging from 15 to 183.5. The estimated growth rate from 1978 to 1986 with respect to this method of measurement was 25.273% (see table 37).

RVD's measured on a per acre basis revealed quite a different story. Recreation use changed from .51 to .58 RVD's per acre during the 1978 to 1986 period, with a high of 1.84 RVD's per acre in 1980 (see table 36 and figure 17). Such drastic variation caused the respective growth rate estimate to not be statistically significant, but its calculated value was -4.990% (see table 38).

Table 36. Net USFS Utah Wilderness/Primitive RVD's and Acreage (High Uintas Excluded)*, 1967-1986

YEAR	RVD's (1000's)	RVD's PER ACRE	ACREAGE
1978	15.00	.51	29,567
1979	39.10	1.30	30,088
1980	55.50	1.84	30,088
1981	46.40	1.54	30,088
1982	43.20	1.44	30,088
1983	25.30	.84	30,088
1984	51.70	1.72	30,088
1985	161.30	.50	319,638
1986	183.50	.58	318,001

Source: USDA, Forest Service

* Until 1978, no wilderness/primitive acreage was designated in Utah other than the High Uintas.

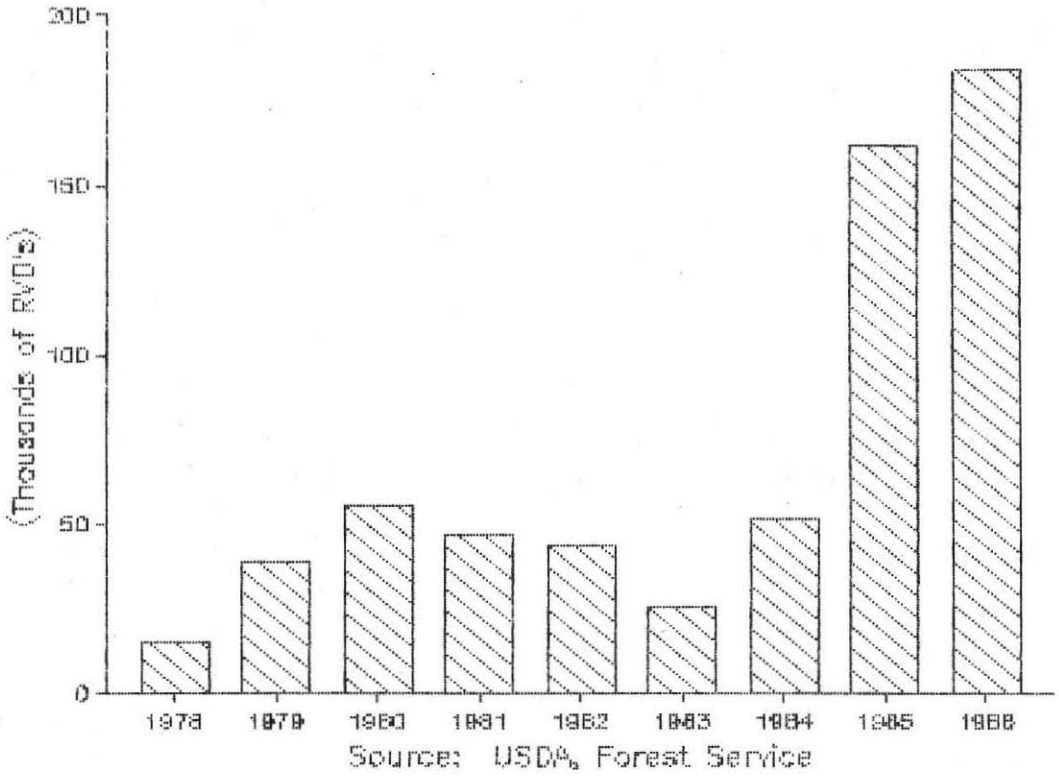

Figure 16. Net USFS Utah wilderness/primitive recreation use (High Uintas excluded), 1978-1986

Table 37. Growth Rate and Regression Statistics of Net USFS Utah Wilderness/Primitive Recreation Use (High Uintas Excluded), 1978-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
1978-1986	25.273	.2253290b (.069378)	.54412	.390670c

b/ Significant at .05 level
c/ Estimated

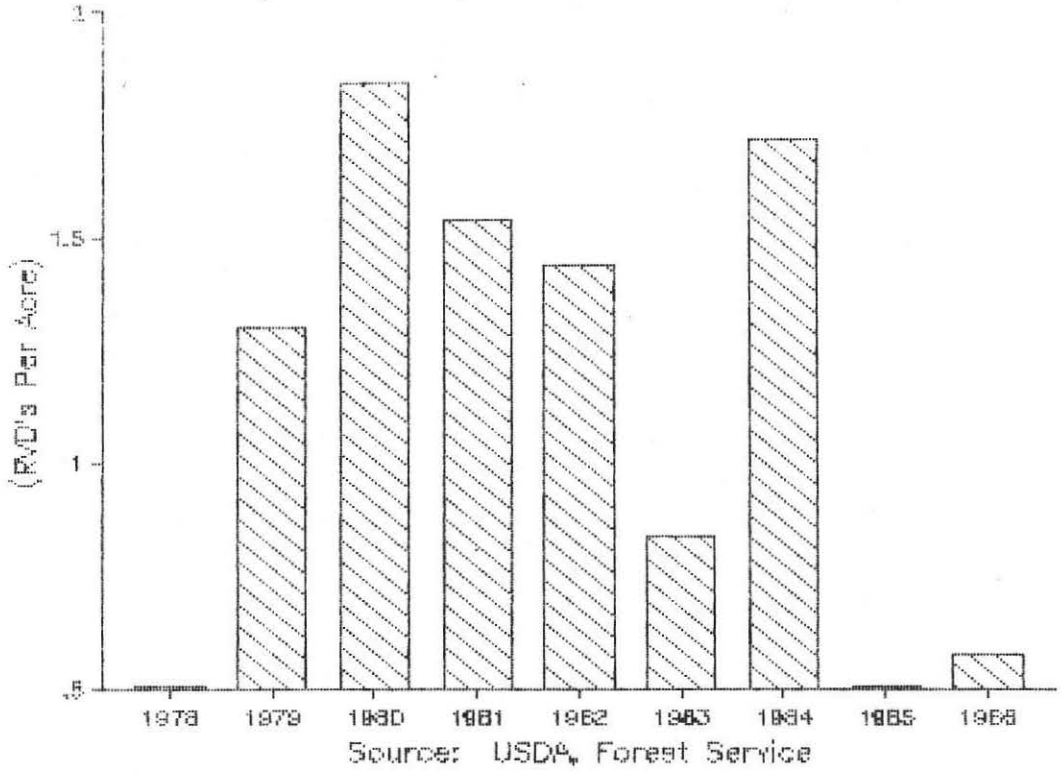

Figure 17. Net USFS Utah wilderness/primitive recreation use per acre (High Uintas excluded), 1978-1986

Table 38. Growth Rate and Regression Statistics of Net USFS Utah Wilderness/Primitive Recreation Use Per Acre (High Uintas Excluded), 1978-1986

	% Compounded Rate of Growth	$\hat{\beta}$	$\bar{R}^2$	ρ
1978-1986	-4.990	-.0511838 (.071659)	-.06522	.212940c

c/ Estimated

CHAPTER VI

SUMMARY AND CONCLUSION

This thesis has been presented in basically two sections. The first section introduced a general classification and discussion of the variables associated with the benefits and costs of wilderness designation. The second section, or the empirical portion of this thesis, examined what has historically been the major element in the complex of variables that society considers important in valuing wilderness--recreation use.

Wilderness designation is indeed one of the most controversial public policy issues in the western United States today. Perhaps what makes it so controversial is the underlying perception of its own character. Proponents argue that wilderness is a state of mind to the beholder. Rather than containing certain objects in a natural setting, it is a resource that offers feelings about those objects. Of course this argument is not unique to wilderness. Other resources enjoyed by society such as movies, opera, and ballet, for example, offer similar subjective attributes of beneficial use. Nonetheless, demands for increased acreage in the national wilderness preservation system cannot be met without imposing costs on society. In spite of this subjectivity (and in some cases because of it), there are fundamental economic variables that exist or have evolved from the Wilderness Act of 1964.

Variables associated with the benefits of wilderness designation were presented in this thesis under three major categories: 1) naturalness preservation, 2) solitude or primitive and unconfined types

of recreation, and 3) special features of scientific, educational, scenic, or historical value. Specific variables were classified under these categories resting on the assumption that benefits derived through wilderness designation are considered unique to such areas (see table 1).

Costs attributed to wilderness designation were presented under two general categories: 1) administration/general management costs and 2) opportunity costs, considered to be foregone opportunities which generally do not represent transfers of cash (see table 2).

Research to date in wilderness economics has typically focused on demand (benefits) with supply (costs) assumed to be constant or perfectly elastic. This convenient assumption has appeared to produce an untenable platform for wilderness resource analysis in general. Until correlative supply response/cost functions are made more available, policy makers will continue to be deprived of adequate information to render efficient resource allocation decisions. The materials compiled in the first section of this thesis were presented in hopes of providing added footing for further research in this area.

The second section of this thesis has analyzed relative comparisons of non-wilderness/primitive and wilderness/primitive recreation uses on USFS lands at Utah, Region 4, and national levels from 1967 to 1986. For added insight, wilderness/primitive recreation use was analyzed in the High Uintas Wilderness/Primitive Area as well as net Utah wilderness (High Uintas excluded) during the same period. All analyses had recreation use measured in general terms (1000's of RVD's), as well as on a per acre basis. Such criteria presented interesting contrasts in the outcome of growth rates derived at various levels over the

twenty-year period studied.

In general terms (1000's of RVD's), non-wilderness/primitive recreation use at Utah, Region 4, and national levels had growth rates of 3.791%, 2.829%, and 2.095%, respectively, from 1967 to 1986. Growth rates evaluated in this form of recreation use on a per acre basis were 4.111%, 3.137%, and 2.579%, respectively.

Analysis of wilderness/primitve recreation use in general terms revealed higher growth rates than non-wilderness/primitive recreation use at all levels from 1967 to 1986. Specifically, growth rates of wilderness/primitive recreation use in general terms were 7.079% in Utah, 3.961% in Region 4, and 4.934% nationally. Growth rates evaluated in this respect on a per acre basis, however, were substantially lower--.858% in Utah, 1.140% in Region 4, and .494% nationally.

Growth rate estimates of recreation use in the High Uintas Wilderness/Primitive Area were 4.935% in general terms, and 1.085% when measured on a per acre basis during the twenty-year period. Net wilderness/primitive recreation use in Utah exhibited perhaps the most striking contrast with a growth rate of 25.273% in general terms, and a growth rate of -4.990% when evaluated on a per acre basis. In this instance the time period used to obtain these later two estimates was from 1978 to 1986, since there were no other wilderness or primitive areas in Utah other than the High Uintas prior to 1978.

It is rather clear that strong discrepancies exist between growth rate measurements expressed in general terms and on a per acre basis. This is particularly true with respect to wilderness/primitive recreation use. Perhaps this could be anticipated, since wilderness/primitive acreage has exhibited a greater percentage change

over the last decade compared to the percentage change in total acreage attributed to non-wilderness. Nonetheless, it seems most appropriate to compare differences in growth rates between various forms of recreation use on a per acre basis. By doing so, more accurate relative comparisons can be made. Moreover, recreation use expressed on a per acre basis over time is essentially a measure of "marginal use" which gives strong reference to a specific form of recreation's marginal value. Growth rate measurements on a per acre basis, then, provide a general indication of such marginal value.

Charting recreational use on a per acre basis at all levels suggested that some forms of recreation did not exhibit consistent growth trends from 1967 to 1986. All forms of recreation use typically peaked around 1980 at every level examined. Non-wilderness/primitive recreation use at Utah, Region 4, and national levels either leveled off after 1980 or exhibited only slightly downward trends. The trend observed for wilderness/primitive recreation use per acre was substantially different, however. Much sharper declines in use were evident from 1980 to 1986. Furthermore, abrupt changes in patterns of wilderness/primitive recreation use per acre after 1976, particularly in Utah, suggested that there were distinct differences in growth rates from 1967-1976 and 1977-1986. Thus, to provide consistency, all levels of wilderness/primitive recreation use per acre were measured during these two ten-year time frames. Wilderness/primitive recreation use per acre growth rates during 1967-1976 and 1977-1986 were, respectively: 1.361% and -5.775% in Utah; 2.562% and -2.613% in Region 4; 4.508% and -4.092% nationally; and 1.361% and -5.715% in the High Uintas Wilderness/Primitive Area. For comparative purposes, a similar analysis

of the growth rates during 1967-1976 and 1977-1986 was performed for non-wilderness/primitive recreation use per acre at all appropriate levels. Specifically, growth rates for 1967-1976 and 1977-1986 were, respectively: 6.164% and 2.360% in Utah; 4.801% and 1.724% in Region 4; and 3.262% and 1.770% nationally.

Rather than attempting to explain the factors affecting growth rate patterns described above, this thesis has primarily outlined "what is" in the dynamics of recreation use for USFS non-wilderness/primitive and wilderness/primitive areas. However, these findings warrant further discussion in reference to fundamental economic theory.

As was suggested earlier in this chapter, the logic of economic efficiency has not been adequately applied to the wilderness issue, especially in recent years. The marginal benefits and marginal costs of each added wilderness area to the National Wilderness Preservation System clearly deserves more attention from decision makers. Generalizing to the degree that wilderness is valued by society in terms of preservation and recreation benefits, the hypothesis that added increments of wilderness for preservation purposes decreases at the margin remains to be tested on a case by case basis. In general, however, logic suggests that it would. The question of what the value of wilderness is for recreation use at the margin (which has been argued to be the greater of the two) has been answered by this thesis--it is decreasing. On the other hand, this research also infers that the marginal value of non-wilderness areas for recreation use is increasing. These findings suggest that, from a recreational perspective, adding wilderness areas to the National Wilderness Preservation System is unjustified.

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APPENDIX

Estimated Recreational Use[a] of National Forests-- Mechanized Travel[b] vs. Total, 1965-1982

(Thousands of Visitor Days)

Year	Mech. Travel	% Annual Growth	Total	% Annual Growth
1965	29,325		160,336	
1966	31,301	6.7	150,729	-6.0
1967	34,889	11.5	149,647	-0.7
1968	36,519	4.7	156,655	4.7
1969	37,832	3.6	162,838	3.9
1970	38,022	0.5	172,555	6.0
1971	41,066	8.0	178,110	3.2
1972	42,275	2.9	183,958	3.3
1973	43,887	3.8	188,175	2.3
1974	44,332	1.0	192,916	2.5
1975	44,836	1.1	199,201	3.3
1976	47,308	5.5	199,928	3.6
1977	49,325	4.3	204,797	2.4
1978	50,970	3.3	218,494	6.7
1979	49,536	-2.8	220,166	0.8
1980	54,998	11.0	233,549	6.1
1981	55,198	0.4	235,709	0.9
1982	53,789	-2.6	233,438	-1.0

Source: Clawson and Van Doren, and USDA Forest Service

[a]As measured in Recreational Visitor Days (RVD's). A visitor day constitutes 12 person hours. It may entail 1 person for 12 hours, 12 persons for 1 hour, or any equivalent combination of individual or group use, either continuous or intermittent.

[b]Mechanized travel, as recognized by the Forest Service, is a general recreational activity made up of automobile, scooter and motorcycle, ice and snowcraft, and other related forms of travel. It does not, however, include any form of boating activity.