THE ROADLESS AREA REVIEW AND EVALUATION

AN APPLICATION OF PROGRAM ANALYSIS IN THE U. S. FOREST SERVICE

Dissertation for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
JOHN PAUL BUTT
1973

This is to certify that the

thesis entitled

The Roadless Area Review and Evaluation

An Application of Program Analysis in the U.S. Forest Service

presented by

John Paul Butt

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in **Forestry**

Robert J. Marty
Major professor

Date **July 25, 1973**

O-7639

ABSTRACT

THE ROADLESS AREA REVIEW AND EVALUATION

By

John Paul Butt

The Roadless Area Review and Evaluation (RARE) is an example of the successful use of program analysis techniques in the U.S. Forest Service. The study and its use in actual decisionmaking are described.

The Forest Service conducted an inventory of all unroaded and undeveloped lands of 5,000 acres or more within the national forests. Over 55 million acres in 1,448 individual areas were identified. From this inventory the Forest Service proposed that 235 areas, including 11 million acres, be classified as "new study areas." These areas would be studied in depth for possible consideration by the Congress as wilderness areas under the Wilderness Act of 1964. During the interim study period all development would be deferred, and the areas would not be included in the calculations of the annual sustained timber yield of the national forests.

The analytical techniques and criteria are described as well as the actual decision process used in selecting new study areas. The study is unique in that several alternative objectives and criteria are compared. Decisionmakers modified the criteria, but rapid computerized data processing permitted reanalysis of the data during the course of a two-day, top management meeting.

The RARE analysis marks a change in Forest Service managerial style toward greater use of modern quantitative analysis techniques. The RARE experience indicates that basic economic theories can provide a systematic way of thinking about and communicating about complex natural resource allocation problems.

THE ROADLESS AREA REVIEW AND EVALUATION

AN APPLICATION OF PROGRAM ANALYSIS IN THE U.S. FOREST SERVICE

By

John Paul Butt

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Forestry

1973

ACKNOWLEDGEMENTS

There were a great many people who participated in the Roadless Area Review, and it would be impossible to even list them. However, there are a few people to whom I owe a great deal for their work and encouragement.

The original members of the "RARE" work party--Bob Rowen, Frank Price, and Arvid Ellson--struggled with me from the beginning, and without their extra efforts it would have been impossible to complete the project. Phil Haug spent many early morning hours babysitting the computer to assure that the analysis was executed within the very tight time constraints.

Dr. Robert Marty provided the guidance and a spirit of optimism that allowed me to overcome many obstacles. I am indebted to Dr. Robert Manthy, whose critical counsel during the planning stages greatly improved the product. Dr. Daniel Chappelle and Dr. Lee James also served on my graduate committee and provided helpful guidance and review.

My boss, Dr. Adrian Gilbert, not only provided me with the time and resources to undertake the project, but he also gave me encouragement, when most needed, to complete my academic work at no small sacrifice to himself and the Forest Service Division of Program and Policy Analysis. And, Barbara Coleman deserves my gratitude for enduring my handwriting and continual changes in the manuscript.

Also, my heartfelt thanks go to my wife Gail and my sons and daughter for their encouragement, and especially for their indulgence during that difficult period of gestation well known to all graduate students.

John P. Butt
Washington, D. C.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

Program analysis gained a foothold in the Federal Government in the midsixties, rose to an immature role of savior of the bureaucracy, and then by the early seventies slid to a less visible but more mature niche in Federal management. During the administration of Secretary of Defense McNamara, Planning-Programming-Budgeting Systems (PPBS) flourished, and in 1965 President Johnson ordered all agencies to adopt PPBS.

The decline of PPBS in the late sixties is attributed to several factors. The system was oversold--capable staffs, analytical techniques, and data bases were not available to accomplish the extensive applications and lofty goals sought. The system was overstructured--there was a blizzard of forms and paper which fell by their own weight. Analyses heightened the level of conflict instead of providing easy answers to problems, as some had expected. Explicitness about costs and effects, and distribution of those costs and effects made the tradeoffs too painfully plain for easy resolution of conflicts. Analyses were discouraged in some cases to reduce the level of conflict.

By 1969 the Nixon administration was quick to drop the unpopular (and Democratic) PPBS image, but many of the basic concepts were even more forcefully applied through a strengthening of the powers of the Office of Management and Budget. Fewer issues were analyzed, but with much greater depth. In addition, there was greater followup in executing decisions and controlling actual performance.

Most proponents of program analysis agreed that to be successful there had to be a top management that wanted to make decisions, wanted to make use of objective analyses, and was willing to make the basis for decisions explicit and visible.

Forest Service Managerial Style Changes

The Forest Service of the U.S. Department of Agriculture was one of the most aggressive agencies in carrying out the PPBS directives in the midsixties. Analysts, such as the author, were given full-time training in economics and program analysis. The Forest Service built a larger program analysis staff than many Federal departments.

However, the early enthusiasm may have been a defensive mechanism to prevent domination by higher authorities. Analysts were used primarily to respond to major program issues raised by the Office of Management and Budget or the Department of Agriculture program analysts. Analysts defended the Service and its budget, but there was no immediate revolution in decisionmaking and planning.

However, a continued training program and persistent attempts at improvement of decisionmaking had brought about a marked change by 1972. Dr. Adrian Gilbert, Director of the Forest Service's Division of Program and Policy Analysis, summarized it this way:

> (PPBS) has not survived as a system. It was oversold, overstructured, and was not integrated with the information systems and analyses needed to successfully execute it.
>
> However, the concepts of PPBS are still very much alive, and the more evolutionary strategy being employed by most agencies should bring more success over the long haul.
>
> Such a strategy requires considerable time and effort. Time is required:
>
> - To develop sound procedures as well as nice theories;
> - To communicate ideas and to gain widespread understanding and commitment;
> - For organizations and people to adjust to new ideas and processes; and
> - To develop the skills and analytical capabilities to achieve quality results . . . .

> I am starting my seventh year in this program planning effort. As I look back, I feel we have made substantial improvements in the last few years. Because of our strategy of merging rather than making a right angle entry, I believe this progress is solid and long lasting.[1]

In 1972 Mr. John McGuire, a forest economist, was appointed Chief of the Forest Service. Mr. McGuire had been the deputy chief in charge of programs and legislation, and he had been responsible for the program planning effort during the late sixties.

These factors combined to make the time ripe for greater utilization of systematic analyses in decisionmaking. In addition, the National Environmental Protection Act reinforced the need for explicit analysis and public involvement, and it formalized some of the procedures for reaching decisions.

In an effort to improve planning a multidisciplinary planning team was established in 1969 to develop a unified planning system for the Forest Service. This study was considered the first attempt at using the unified planning concept.

This first effort is important because it seems to mark a change in managerial style. It is the first major program issue analysis initiated by the Forest Service in a nontimber program area. Almost all major program issues had previously been "demand performances" for the Office of Management and Budget and most issues focused on timber management problems.

---

[1]From a speech on "Multi-Year Program Planning" by Dr. Gilbert delivered to Forest Service top management at a regional foresters and directors meeting, February 1-4, 1972.

Following the key decisionmaking session Chief John McGuire wrote: to his line officers:

> I am very happy with the result of our meetings last week and wish to thank each of you for your contribution to their success. I was pleased to learn that you also viewed the session to be an effective way of coming to grips with difficult questions. I believe that executive sessions of this kind are a necessary and important means of improving the communication between organizational levels that is vital to effective decisionmaking at all levels. This is a facet of the Executive Planning/Decisionmaking Process that we can move forward with implementing immediately at each level of this organization.[1]

Purpose of the Case Study

This case study is written to document this important step in Forest Service planning and policymaking. History may be a better judge of the significance, and other analyses can yield other insights into changes in the Forest Service and other land management agencies. However, the intent of this case study is to provide some insight into how the roadless area review and evaluation evolved, how the analysis was planned and carried out, and how it was used by top managers.

Hopefully, this case study can provide a basis for critique and further progress in the utilization of program analysis techniques in the Forest Service and other agencies. Perhaps the study will provide a ray of optimism that systematic analyses can be applied within complex bureaucracies such as the Forest Service, and that there is hope for

---

[1]Memorandum from John R. McGuire, chief, to regional foresters, directors, and area directors concerning "Executive Planning/Decisionmaking Process," December 20, 1972, (file designation 1360, Meetings).

continual improvement of management in the future. Students of public administration and economics may find the study of value in better understanding how agencies, analytical teams, and decisionmakers act in actual management situations. Seldom are these types of top management decision processes opened to this kind of documentation. This itself is a reflection of a change to "openness" in management.

The Roadless Area Review

The roadless area review and evaluation is one of the most important problems faced by the Forest Service in this decade. In the past few years preservationist groups and industrial interests have squared off over the issue of how much land, particularly national forest land, should be devoted to wilderness.

The Forest Service administers 186 million acres of land or 5 percent of the land area of the United States. Of this, 15 million acres or 8 percent is already in the wilderness system as wilderness or primitive areas. Another 56 million acres or 25 percent is still essentially roadless and undeveloped.

The future use of this land is in conflict. Demands for timber products, mineral products, and other goods and services are high, and roads and ecosystem manipulations are often needed to produce these outputs. Such development essentially precludes the use of an area as wilderness and the change is irreversible.

In past years, area after area has been a focal point of this conflict. However, there was no overall plan for resolving the conflict, and the brush fire approach was making orderly planning difficult. Delays and changes in plans were causing serious disruptions in the flow of outputs, and costs were becoming excessive.

The Forest Service, to bring some order, accelerated the identification of areas which had the greatest potential for addition to the national wilderness preservation system. A list of "new study areas" would be identified. All development of these lands would be postponed until in-depth studies had been made and recommendations had been made to the President and Congress on eventual management. The annual allowable timber harvest contributed by the new study areas would be subtracted from the allowable harvest of the national forest system. The new study areas would be analyzed in-depth over the next decade or more.

The selection of these new study areas is the central issue of the roadless area review and evaluation and this study.

Organization of this Paper

Chapter II, Wilderness and the Forest Service, provides a brief review of the history of the wilderness movement in this country, and the Forest Service leadership in the movement. Wilderness is defined in an institutional framework, and also in a social value framework. The values of wilderness, as described in the literature, are briefly reviewed.

Chapter III, The Roadless Area Review, traces the evolution of the roadless area review prior to the time that a national task force was assigned to provide a program analysis effort. A total of 1,448 roadless tracts, containing 56 million acres were identified during a two-year field inventory. The inventory of roadless areas is described, as well as the criteria used by field units in formulating their recommendations to the chief for new study areas. The largest "public involvement" effort ever attempted by the Forest Service was a part of the review process and this effort itself deserves a separate dissertation effort.

Chapter IV, The RARE Analysis, describes the planning, execution, and evolution of the national roadless area review and evaluation which began in April 1972. The development of decision criteria and the indicators of effectiveness and cost are discussed in detail. This analysis is somewhat unique in the program analysis literature, in that several alternative objectives are addressed. Much of the literature is centered on techniques which optimize on a single objective, but in most political situations the objectives are usually multiple, often obscure, and sometimes contradictory.

Chapter V, Results of Analysis, provides the detailed results of the analytical process described in Chapter IV. The 1,448 roadless areas were each screened and placed into three categories of highest priority, lowest priority, and intermediate. The intermediate areas, which include two-thirds of the areas were ranked in decreasing priority using five alternative criteria. The alternative criteria are quantitatively compared and the cumulative effects of a variable size of new study area list are analyzed. A newly developed Forest Service data processing system was utilized in conducting the analysis.

Chapter VI, Use of the Analysis, describes how the analysis was presented to top line officers. The line officers met for a two-day session in December 1972 to decide upon the Forest Service proposed list of new study areas, and the decision process is described in detail. The acceptance and rejection of certain criteria are discussed. The line officers adopted some new criteria during the course of the meeting, and rapid data retreival capability provided a means to respond to the changes in criteria so that decisions could be reached.

An ex post facto analysis of the decision is provided to gain some insight into the objectives implied by the actual decisions. The future use of the analytical system is also discussed along with a few conclusions about the significance of the roadless area review and evaluation.

II. WILDERNESS AND THE FOREST SERVICE

It may seem paradoxical that one of our public controversies in this age of space exploration and cultural advance should be the preservation of wilderness areas, where the benefits of civilization and technology are purposely suppressed. However, McCloskey (1966) has argued that "wilderness is an idealized conception of nature in pure form that becomes generally prized only in advanced cultures." Wilderness is a social and cultural phenomenon of the highest order.

Wilderness areas provide value to certain people and those who benefit strive to increase the net benefits to themselves. If all land was a free good with no alternative values to people then there would be no barrier to people in maximizing both their wilderness and other benefits simultaneously. Such was the case when only the American Indians and the first white settlers inhabited the United States. Today the only free land situation is found on the moon and other planets, and this land predictably will one day become scarce. However, in 1973, in the United States, land is a scarce resource and such scarcity for many alternative uses creates socioeconomic values. The continual bidding that occurs in either the free market or in a political allocation system tends to assure that the socioeconomic value of any land use exceeds the value of the next best alternative. The opportunity cost principle is that the social cost of one alternative is the social benefit or value of the next best alternative. As soon as land use bidding begins the exchange value rises above zero.

What is Wilderness?

A review of the literature and the plethora of descriptions and definitions indicates that wilderness is as difficult to define as the home. As in the home, there is a bundle of activities, satisfactions, taboos, and norms which take place in a habitat. The activities and values of wilderness and the home, even if they could be precisely defined for the individual, change over time and space--there is considerable uniqueness and variation. It is much easier to define the particular physical habitat--the house.

Without belaboring the history and semantics I'll simply begin with the institutionalized definition of a wilderness area provided in the Wilderness Act of 1964.

> . . . an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value (U.S. Congress, 1964).

While this definition has a few ragged edges which are still a source of controversy, such an institutionalized definition still provides the best guidence for picturing "the house."

Aldo Leopold (1921) who lead the early recreation management in the U. S. Forest Service, perhaps keynoted the Federal Government's recognition of the increasing scarcity of land for wilderness.

> Pinchot's promise of development [of the National Forests] has been made good. The process must, of course, continue indefinitely. But, it has already gone far enough to raise the question of whether the policy of development (construed in the narrower sense of industrial development) should continue to govern in absolutely every instance, or whether the principle of highest use does not itself demand that representative portions of some forests be preserved as wilderness.

Wilderness is now recognized as a land use having considerable social value. The allocation of scarce resources among competing social uses is the subject of political economics and the subject of this treatise. Generally, our culture has accepted the objective of allocating resources to their highest and best use. Yet, we flounder and fight over how to measure "highest and best," especially when decisions must be made in the political arena rather than in the market. Conflicts also arise because the benefits and costs of any allocation are unevenly distributed among the population.

The Forest Service and its line decisionmakers are faced with the responsibility of resolving these difficult land allocation questions. The place of scientists is to help elected public representatives or agencies, such as the Forest Service, make such decisions by continually striving to improve the objective means to measure highest and best use; however elusive the ultimate criteria may be.

Wilderness Values and Activities

The activities which take place within wilderness areas further define wilderness. The primary satisfying activity in wilderness areas is the "wilderness experience." Many writers and researchers have explored the sociological and psychological motivations underlying the wilderness experience.[1] In general, visitors to wilderness areas come for a complex array of reasons and motivations which for the present purpose can be categorized as leisure or recreation activities where isolation and "oneness with nature" are the primary essential ingredients. Some visitors can find a satisfactory experience only in wilderness areas, and they can be referred to as "purists." Other visitors can find equally satisfactory experiences in other areas, but they utilize wilderness areas because of habit, convenience, cost, or lack of alternative areas.

A secondary kind of vicarious value accrues to some individuals as an existence value or an option value. That is, a person attaches value to confirmed knowledge that wilderness areas exist even though the person may never actually use the area. The option value reflects the value a person attaches to knowledge that wilderness areas will be available for possible future use by himself or others. Tombaugh (1970) has described and attempted to measure such values attributed to National Parks.

---

[1] A partial list of contributions on this subject: McCloskey, 1966; Gilligan, 1953; Nash, 1967; Hughes, 1968; Outdoor Recreation Resources Review Commission, 1962; Catton, 1969; Merriam, 1968; Stankey, 1971; Hendee, Catton, Marlow, and Brockman, 1968; McKinley, 1963.

The literature also refers to the "cultural" values of wilderness in the sense that wilderness areas are a kind of natural monument to America's pioneer and wilderness heritage (McCloskey, 1966). This type of existence value is probably one of the strongest in attracting national political attention. Wilderness as an institution is unique to America, and its cultural and artistic roots are eloquently traced by Nash in Wilderness and the American Mind (1967).

Wilderness advocates also acclaim significant "external benefits." For instance, scientific research served by wilderness areas might provide knowledge that will benefit people who are not even aware of the existence of wilderness. Very little concrete evidence of such values has been described in the scientific literature, but the possibility that such values exist has been a significant factor in the rhetoric.

Similarly, educational values are attributed to wilderness. Wilderness learned or inspired behavior may benefit other members of society (the possibility of disbenefits is not stressed). The educational value has only vaguely been discussed in the literature, and wilderness educational values have not been compared with alternative educational means.

Preservation of historic, geologic, or other unique natural features has been described as a wilderness value. Such features can, of course, be preserved by institutional arrangements other than wilderness. If such features derive their value from their attractiveness to visitors, then they can be thought of as input factors in providing the direct recreational values. However, such features may also provide some existence or option value to nonvisitors.

History of the Existing Wilderness System

The first wilderness proposal was made by Aldo Leopold of the U.S. Forest Service in 1921, when he proposed a wilderness system of large undisturbed areas "big enough to absorb a two week's pack trip and kept devoid of roads, artificial trails, cottages, or other works of man." He set a system goal of "probably not to exceed one in each state." The first area he proposed was the half million acre headwaters of the Gila River on the Gila National Forest in New Mexico (Leopold, 1921). In 1924 the area was designated as the first Forest Service wilderness area.

The first roadless area inventory was conducted two years later. To be considered in the inventory, tracts had to be at least 230,000 acres, a criterion related to Leopold's concept of minimum size. In 1929 Regulation L-20 was established by the Secretary of Agriculture to provide for the designation of "primitive areas." Subsequently, seventy-three areas were designated in the primitive area system. The regulations were tightened by Robert Marshall, head of the Division of Recreation and Lands in the Forest Service and a founder of the Wilderness Society. Ambiguities in L-20 were clarified by new regulations (U-1, U-2, and U-3) which defined wilderness, wild, and roadless areas. Wilderness areas had to be at least 100,000 acres in size. Areas between 5,000 and 100,000 acres could be classified as wild areas. Roadless areas were to be managed principally for recreation in a natural environment, but other uses could be permitted. Primitive areas were to be studied for possible reclassification as wilderness or wild areas. By 1940 there were seventy-three wilderness, wild, or primitive areas comprising over fourteen million acres.

During the period 1935-1964 very little acreage was added or deleted. Various wilderness organizations sought more permanence in wilderness designations by proposing congressional action. Foresters and the forester-dominated Forest Service acquired a threatening image to preservationists because of an alleged dominant philosophy of development and intensive timber culture. A dessertation by J.P. Gilligan (1953) concluded that "In view of the primary purposes of national forests and the prevailing training and opinions of foresters, preservation of large wilderness areas in the future seems unlikely. Fundamentally, the practice of forestry is the very antithesis of wilderness preservation."

It is paradoxical that the agency which pioneered the wilderness concept could be assailed with such a charge. Other Federal land managing agencies--the Park Service, the Bureau of Sport Fisheries, and the Bureau of Land Management--administered areas which provided wilderness type experiences, but under these agencies there was even less formal assurance of management designed to maximize wilderness values.

The pressure of statutory classification grew and culminated in the passage of Wilderness Act of 1964. The Wilderness Act defined wildernesses, the procedures for designating them, and the conditions of use. All of the areas which had been classified under the Secretary of Agriculture Regulations U-1, U-2, and U-3 as "wilderness," "wild," or "canoe" areas were designated as "wilderness" areas. The legislation also directed the Forest Service to review the remaining primitive areas and make recommendations to the President and Congress within ten years (by 1974). In addition, the Secretary of the Interior was directed to review every roadless area of 5,000 contiguous acres or more in the

national parks, national monuments, and national wildlife refuges for possible inclusion in the national wilderness preservation system.

There are now 64 national forest wilderness areas containing 10.7 million acres. Reviews are complete and awaiting congressional action on 12 primitive areas, and 11 others are now under study and scheduled for completion by the target date of 1974 (Table 1.)

TABLE 1.--State of the wilderness preservation system, January 1, 1973

Item	National Forest System		National Park System		National Wildlife Refuge System	
	No.	Acres (millions)	No.	Acres (millions)	No.	Acres (millions)
Areas classified as wilderness by the 1964 Act	54	9.1	0	0	0	0
Areas requiring review under the 1964 Act	34	5.5	62	28.0	81	26.0
Review completed with decision made against inclusion	0	0	a	a	1	a
Reviews completed and sent to the President and Congress	24[a]	3.4[b]	a	a	28	0.5
Total classified	66	10.7	4	.2	25	.1

[a]Not available

[b]Twenty-three primitive areas plus Scapegoat Wilderness (not previously a primitive area).

Thus, the Forest Service had been aggressive in complying with the Wilderness Act, and in the early seventies the agency was looking beyond the required primitive area reviews.

The Department of Interior's bureaus had an even larger review mandate under the Wilderness Act. About 54 million acres of national parks and national wildlife refuges met the conditions specified in the Act. Of the 143 areas being reviewed, 29 containing 0.3 million acres have been classified as wilderness. Thus, review and action is still pending on most of the 54 million acres. In addition, the Bureau of Land Management is under pressure to consider wilderness land use alternatives on about 100 million acres of essentially unroaded land in the West. The Bureau of Land Management was not required under the Wilderness Act to review any of the lands it administers. The Forest Service is a major supplier of potential wilderness areas, but it is not the only agency nor even the predominant agency in terms of suitable acreage.

The Wilderness Act itself did not result in any significant change in the allocation of national forest land to wilderness use. Only the procedures, names, and authorities were changed. In 1973 there are still 14.8 million acres managed under the wilderness system, only 0.6 million more than in 1940. The slight changes in Interior administered wilderness areas further lead to the conclusion that the supply of designated wildernesses had remained relatively stable for 30 years.

However, passage of the Wilderness Act and the publicity and political controversy surrounding it undoubtedly stimulated more demand for wilderness use. During the period 1950 to 1970 the reported use of the national forest wilderness system increased from 300,000 recreation

visitor days[1] to over 5.7 million. Although the data are subject to considerable uncertainty, it seems very evident that the demand for and use of national forest wilderness areas is growing, probably at a current rate of 6 percent or more per year. By the year 1980 it would not be unreasonable to expect eight to ten million visitor days, and by the year 2000, 20 million might be expected without any increase in the acreage of the existing national forest wilderness system.

In addition to the direct visitor demand increases, the same political pressures for enlargement of the national forest portion of the wilderness system continued through the sixties and into the seventies. This set the stage for the second Forest Service roadless area inventory and reviews.

---

[1]A visitor day is a 12 person-hour unit of visitation.

III. THE ROADLESS AREA REVIEW

Following passage of the Wilderness Act in 1964 the Forest Service devoted considerable effort to studying the 34 remaining primitive areas as required by the act. In addition, there was a considerable effort in the early sixties to intensify multiple-use planning in response to passage of the Multiple-Use Sustained-Yield Act of 1960.

Identification of additional areas which could or should be added to the wilderness system took a lower priority. And, in fact, there was no requirement in the Wilderness Act to review national forest areas other than those primitive areas specified in the act. However, the Forest Service felt other areas should be identified over time, and directives were issued to regional foresters to identify such areas by July 1, 1970.[1] Numerous proposals were advanced by preservationist groups, but only one--the Scapegoat Wilderness in Montana--was acceptable to the administration and Congress.

Progress on identification of new areas lagged and in May 1969 the directives were revised to require a due date of June 30, 1972.[2] Progress still lagged and pressure for resolving the longer run allocation questions grew. Preservationists argued that potential wilderness areas would be lost by irreversible developments before they could be adequately studied. Industrial interests argued that lawsuits and controversies over numerous areas made planning difficult, and long-range investments in plants and transportation systems were very risky.

---

[1]Forest Service Manual, Chapter 2320, 1967.

[2]Ibid., Amendment No. 35, May 1969.

In February 1971, the chief of the Forest Service issued a strong letter to his regional foresters to meet the June 30, 1972, deadline.[1] He said:

> We must make every effort to meet this objective The longer these decisions are delayed the greater is the danger that areas which should be added to the Wilderness System may be inadvertently compromised by uses or developments not compatible with wilderness classification. Conversely, until these decisions have been made there will be continuing uncertainty and growing controversy over existing development or commodity use into any unroaded areas, whether or not such use is desirable from a resource management standpoint. While such decisions will not put an end to all controversy, they should give us a sound basis for judgement on the issues. Another reason for getting on with this job is that in order to properly plan for it we need an indication of the size of the wilderness study job ahead.

This stimulated regions into a flurry of activity. A letter to the regional foresters in August 1971 clarified the procedures to be used.[2] The letter emphasized the multiple-use planning process, public involvement, and use of the criteria of suitability, availability, and need for wilderness.

---

[1]Memorandum from Chief Edward Cliff to regional foresters, February 25, 1971, (file designation 2100, Multiple Use).

[2]Memorandum from Chief Edward Cliff to regional foresters, August 11, 1971, (file designation 2100, Multiple Use).

Suitability, Availability, and Need

To guide field officers in studying areas for possible inclusion in the wilderness system, the Forest Service issued guidelines entitled "Eastablishment, Modification, or Elimination [of Wilderness]."

The guideline states:[1]

> In considering the possible establishment or modification of Wilderness, Forest officers will analyze all public values of land and identify the highest public value. To merit recommendations of the Forest Service for inclusion in the National Wilderness Preservation System, the area involved must meet the tests of suitability, availability, and need.

The manual then elaborates on the criteria of suitability, availability, and need. The sometimes ambiguous manual can be summarized as follows:

- Suitability is the minimum condition which satisfies the Wilderness Act definition,
- Availability is conditioned by the value and need for wilderness compared to its value and need for other purposes. To be considered available, wilderness designation must represent the highest and best use of the land over a long period of time,
- Need is a component of availability, and the manual states that "Values are relative, and the need for the Wilderness resource cannot be considered wholly apart of the demand for other services of the land which might be incompatible with Wilderness. Nevertheless, the purpose of the special classification being to provide

---

[1]Forest Service Manual, loc. cit.

> for the American people an enduring resource of Wilderness, it is essential to separately analyze the need for Wilderness in order to establish its relative value."

The criteria of suitability, availability, and need do little more than establish that "highest and best use" should be the criteria, but the manual offers no explicit measures for comparing the good and bad or the benefits and costs.

These guidelines provided the basis for regional foresters to inventory all remaining roadless areas of the national forests, and to recommend which of those areas should be studied for possible inclusion in the wilderness system.

The Roadless Area Inventory

Field officers set out to identify all of the remaining roadless and undeveloped tracts of national forest land. There were some difficulties in the inventory due to the vageness of directives.

The August 1971, memorandum from the chief to the regional foresters took a narrow view of suitability. It stated, "Each Region will identify presently unroaded and unclassified National Forest lands in units of not less than 5,000 acres."

In a March 1972 "white paper" the Forest Service described the inventory as follows:[1]

> First, each National Forest area of 5,000 acres or more which is unroaded and undeveloped has been inventoried. Contiguous to existing Wildernesses and Primitive Areas, smaller units are also identified.

---

[1]Memorandum from Associate Chief John McGuire to regional foresters, March 1, 1972, (file designation 2100, Multiple Use). A paper was attached titled "Multiple Use Management Review of Undeveloped Roadless Areas on the National Forests," 2 pages.

The inventory resulted in the listing and mapping of 1,448 tracts of land occupying 56 million acres as of June 30, 1972, (Table 2, Figure 1). This is an area larger than Utah, and represents 25 percent of the gross area of the national forest system. The inventoried areas contained 18.6 million acres of commercial forest land (timber growth exceeding 20 board feet per acre per year). The approximate annual sustained timber yield was 2.3 billion board feet per year, about 17 percent of the 13.6 billion board feet for the entire national forest system. About 250 areas containing 8.5 million acres were adjacent to existing wilderness and primitive areas.

In the eastern United States only three areas containing 45,000 acres were inventoried out of the 45 million acres of national forest system lands in the East. The eastern national forests were acquired lands which were usually abused or in tax default status at the time of acquisition. Although many of these areas have "healed" substantially, Forest Service field officers felt that such lands, except for three inventoried areas, could not be considered unroaded and undeveloped because of lingering evidence of man's past land uses.[1]

Problems arose in defining just what constituted a road or a development. Would an old wagon track, or a jeep track established by overland vehicle use constitute a road? Regions developed their own guides for resolving this issue with only informal guidance from Washington. In general, the intent was to overlook unconstructed roads or developments which could be removed without long lasting evidence of man's influence on

---

[1]Alternatives are now under review by the administration for providing a primitive recreation area system in the East. The eastern "wilderness" situation was handled as a problem separate from the roadless area review.

TABLE 2.--Summary of roadless area inventory by regions

Region	Number of areas	Gross acres (thousands)	Commercial forest land acres (thousands)	Annual allowable timber harvest/yr. (million bd. ft.)
Northern	283	8,116	4,748	466
Rocky Mountain	249	5,988	2,502	136
Southwestern	89	1,188	160	47
Intermountain	434	11,466	3,656	172
California	127	3,041	708	208
Pacific NW	256	5,600	3,181	698
Southern	2	37	23	
Eastern	0	0	0	0
Alaska	7	20,554	3,647	580
Puerto Rico	1	8		0
Total	1,448	55,998	18,625	2,307

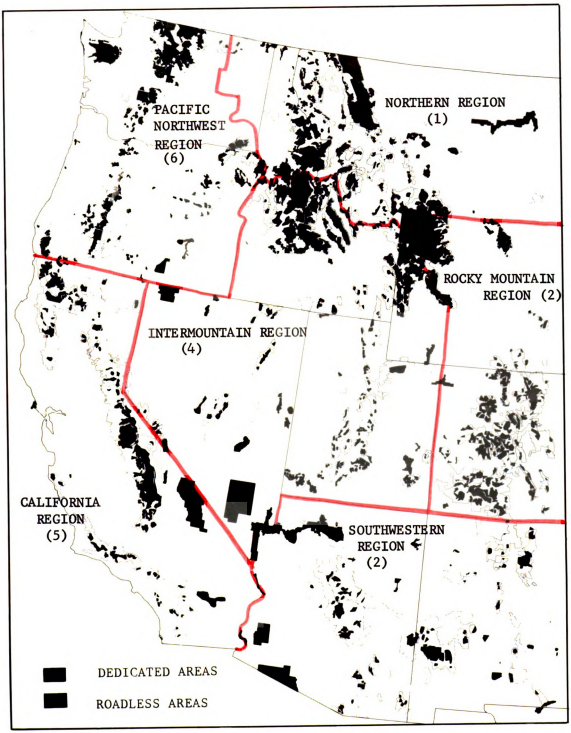


Figure 1.--Map of roadless areas.

the landscape. Within the total inventory 659 areas containing 35.1 million acres[1] contain some minor developments or unconstructed roads which field officers felt would not render the areas unsuitable for wilderness study.

During and following the inventory, field officers studied the areas using the criteria of suitability, availability, and need. In addition, they undertook a massive public involvement effort.

---

[1]One area in Alaska contained 18 million acres.

Public Involvement

In the late sixties, as part of the environmental movement, concern shifted toward formalized involvement of "the public" in administrative decisionmaking. The National Environmental Policy Act of 1969 required that environmental statements be made available to the public before major decisions were finalized.

In Chief Cliff's February 1971 memorandum to regional foresters, he emphasized that "The public should be involved in the process, and a record of each such involvement should be made."

The public involvement effort made in the roadless area review was the most extensive ever attempted by the Forest Service. Over 300 public meetings were held; more than 25,000 people participated.

This public involvement effort probably had a considerable influence on forest supervisors' and regional foresters' recommendations to the chief in June 1972. There was a considerable variety of techniques used and the intensity of public involvement varied greatly. Other studies are underway to evaluate the public involvement effort as a basis for improving techniques to be used in the future, and this aspect of the roadless area review will not be explored in-depth here.

To provide some basis for summarizing the public involvement, each roadless area was categorized into one of four public response categories:

1. General uniform support for new study area status,
2. General opposition to new study area status,
3. Opinions divided, and
4. No opinion expressed or so little that classification was not possible.

These categories were quite useful in the national analysis, even though the criteria for clasification were rather loose. It is possible that those who classified the public involvement tended to see and hear what they wanted to. There was no objective means available to test the reliability of data, but it was presumed to be a reasonably accurate summary of the expressed public opinion.

In addition, a qualitative summary of the local and regional public involvement effort was prepared for each region and the nation.

Regional Foresters' Tentative Recommendations

Following the intensive public involvement at the local and regional levels, regional foresters made tentative recommendations on which roadless areas should be new study areas.

Of the 1,448 roadless areas inventoried, the regional foresters tentatively recommended 181 areas. The recommended areas contained six million acres, or 11 percent of the 56 million acres inventoried (Table 3).

In addition, there were 61 areas that were already under study. These 61 areas included 47 which were being studied in connection with adjacent primitive areas which were being reviewed under the Wilderness Act mandate. An additional ten roadless areas were previously committed to intensive wilderness study as a result of "The North Cascades Study" conducted by the Departments of Agriculture and Interior in 1965 (North Cascades Study Team, 1965). Four areas in Alaska previously designated by the chief as new study areas complete the list of 61.

The guiding criteria for these recommendations were "suitability, availability, and need," but the regions made little headway in more explicitly defining the terms and means of measurements. In addition, the National Environmental Policy Act required that analyses be made explicit.

TABLE 3.--Summary of areas tentatively recommended for study by regional foresters July 1, 1972

Region	Total number of areas	Number adjacent to existing Wilderness-Primitive Areas	Gross acres (thousands)	Commercial forest land acres (thousands)	Annual allowable timber harvest/yr. (million bd. ft.)
Northern	27	13	1,435	641	50
Rocky Mountain	30	19	807	269	13
Southwestern	47	14	833	89	45
Intermountain	40	14	1,953	589	19
California	16	10	480	97	23
Pacific NW	17	10	372	229	45
Southern	1	0	22	12	1
Eastern	0	0	0	0	0
Alaska	2	0	144	65	6
Puerto Rico	1	0	8	0.4	0
Total	181	80	6,054	1,991	202

The Washington office imposed a directive that required an environmental analysis report for each roadless area.[1] Such reports were intended to be vehicles for reaching decisions and the required outline was similar to the one required in formal environmental statements.

The environmental analyses reports included the forest supervisors' recommendations which the regional foresters approved or disapproved, sometimes formally, and in some cases without any documentation. A Washington office review of the environmental analyses reports indicated they were rather weak, and the criteria for recommendations were sometimes vague. This weakness was due in large part to the immensity of the job in such a short time period. Over 900 reports were prepared on the 1,448 roadless areas. Some forest reports covered several roadless areas.

Regions also supplemented the environmental analysis reports with various kinds of regional analyses which in most cases were informal. However, one region used a quantitative rating system to good advantage. Undoubtedly, public involvement inputs and professional opinions of the staff people involved played a major role in formulating the regional foresters' recommendations.

---

[1]Memorandum from Associate Chief John McGuire to regional foresters, March 1, 1972, (file designation 2100, Multiple Use).

The Roadless Area Review and Evaluation

In the early part of 1972 the Washington office of the Forest Service had not yet developed a procedure for reviewing the regional foresters' recommendations. There were many questions. It was unclear as to whether or not the chief would consider areas other than those tentatively recommended by regional foresters. There was concern about how the new study areas were to be managed during the interim period before studies were complete. Many of these issues involved several functional areas and there was little coordinated effort exerted.

At this particular time in the evolution of the Forest Service there was also a quiet but sincere movement underway to improve planning and decisionmaking. The movement perhaps had its roots in the planning-programing-budgeting effort in the early sixties. However, the movement was also an outgrowth of the rapid advances in quantitative analyses techniques made possible by greater availability of computerized data processing. This effort was centered in the Forest Service's Division of Program and Policy Analysis. Another focal point in the organization was a "multidisciplinary planning team" established to develop an overall Forest Service planning process. The time was ripe for a concerted effort to utilize program analyses techniques in one of the most important land use allocation problems faced by the Forest Service.

In April of 1972 only 2-1/2 months before the regional foresters' recommendations and the inventory data were due, the chief established a "roadless area review and evaluation task force." He gave it this charge.

> The mission of the Roadless Area Review and Evaluation Task Force will be to apply the best available program analysis techniques to help us review the Regional Foresters' recommendations (in the context of the inventory from which recommended areas were selected) and to identify and compare the relevant alternatives on a

> national basis. The effort will help us reach conclusions about the number and distribution of areas to intensively study for possible wilderness classification. The evaluation will have to address objectively the basic economic and social issues involved in the relative "availability" of land and "need" for wilderness as well as the "suitability" factors discussed in FSM 2321, Criteria. This staff analysis will supplement and complement our public involvement activities, and it will not be the sole means for reaching decisions.[1]

The task force consisted of a six-man "steering committee" which provided interim policy guidance and a four-man "work party" to carry out the analysis. I was assigned to the work party as the principal program analyst and economist.

---

[1]Memorandum from Chief Edward Cliff to deputy chiefs, April 11, 1972, (file designation 1310 Planning, 2320 Wilderness and Primitive Areas).

IV. THE "RARE" ANALYSIS

This chapter describes the planning, execution, and evolution of the national roadless area review and evaluation (RARE) which was conducted during the period April to December 1972. The results of the analysis and their use in the decision process are reserved for later chapters.

It is important to note the rather unique environment in which the analysis was carried out. Thoughout the program analysis literature it is reiterated that one key to successful use of program analysis is a close tie between analysts and decisionmakers. The RARE task force approach provided a means for achieving this environment. The analysis was not conducted in an isolated research or academic atmosphere, but rather as a priority administrative job. This kind of top management support made the integration of skills and various production units possible. Without such priority the analysis would undoubtedly have been much less effective.

Immediately after its formation, the work party met and attempted to set forth the specific goals it would try to achieve. The work party began with three tentative objectives:

1. Development of proposed chief's list of new study areas selected from the unroaded inventory provided by regional foresters.
2. Identification and comparison of relevant alternatives; development of criteria for such comparisons.
3. Objective assessment of social and environmental issues.

The first objective was a source of some controversy within the task force. Some felt the task force effort should be limited to items 2 and 3, while others felt making a definite proposal for approval by the chief

should predominate. By December the more analytically oriented school of thought predominated and the stated objectives of the task force analysis were:

1. To compare alternative criteria for selecting new study areas.
2. To provide estimates of the potential costs and benefits associated with the alternative lists of roadless areas recommended for further study.

To accomplish the task force objectives the work party set forth, in a traditional program analysis approach, to first define the problem and the social objectives. Then, criteria were designed to analyse and compare the 1,448 alternative roadless areas.

The Program Objectives

To distinguish between the task force analysis objectives and the overall agency objectives, I use the term program objectives for the latter. Program objectives are the end conditions that are sought by the agency in making resource allocations that are in the public interest.

The first attempts at defining tentative program objectives brought out a basic difficulty usually encountered in program analysis--defining the right objectives or knowing when the objectives are right. In effect, multiple objectives became alternative objectives, and a higher level objective which integrated them was impossible to define. No single measure of value could be found which would point the way to the optimum public interest. In part this was due to a lack of agreement on appropriate objectives by task force members with different program backgrounds.

McKean (1967) has pointed out the necessity and the inevitability of what he calls "suboptimization" in these terms:

> . . . this prescription helps little more than saying that we want the best. Nobody knows precisely how satisfaction, military worth, and national well-being are related to the observable outcomes of various courses of action. We have not the models or the wit to translate those outcomes into such terms. In practical problem solving, therefore, we have to look at some "proximate" criterion which serves, we hope, to reflect what is happening to satisfaction, profits, or well-being. Actual criteria are the practicable substitutes for the maximization of whatever we would ultimately like to maximize.

Many scholars have sought criteria by which the public interest could be judged, but the only conclusion is that there is no "best" or "correct" theory of the public interest (Schubert, 1960). Thus, the work party chose not to limit its analysis to a single objective, which would have been the simplest kind of analysis to conduct, but rather an attempt was made to deal with multiple and partial objectives. Alternative criteria or objectives would be presented to decisionmakers, so that there would be an opportunity to better define program objectives as well as to select a list of proposed new study areas. Obviously, public involvement, court actions, political pressures, and other factors outside the analysis would also influence the decision process.

The work party reviewed the Multiple-Use Sustained-Yield Act of 1960, and the Framework for the Future, a set of 12 broad Forest Service objectives (U.S. Forest Service, 1970). However, no single objective could be determined. Following a few hours discussion, the first tentative set of objectives were:

1. Create a viable and adequate national forest wilderness preservation system.

2. Determine the best allocation or use of the roadless area.
3. Determine the best mix of values for people.
4. Maximize wilderness values.
5. Maximize timber benefits.

These first tentative objectives helped get the effort underway, but it became obvious the goals needed to be restated. Terms like "viable," "adequate," and "best" were ambiguous; some of the objectives appeared synonomous, others were much too narrow. The attention shifted to more specific criteria, and after a series of study plan revisions and evaluation of preliminary results, the task force offered five alternative program objectives:

1. To obtain the most wilderness value relative to the cost and value of forgone opportunities to produce other goods and services for society.
2. To spatially disperse the future wilderness system as widely as possible over the United States.
3. To represent as many major ecosystems as possible to serve the scientific and educational purposes of wilderness preservation.
4. To obtain the most wilderness value with the least relative impact on the Nations' timber product output.
5. To locate some new wilderness areas closer to the places where people live so that more people can directly enjoy their benefits.

Economic Theory

Economic theory provided much of the basis for developing the criteria to compare alternative roadless areas. Several economists have explored the use of economic theory in wilderness allocation problems (Outdoor Recreation Resources Review Commission, 1962; Fisher, Krutilla, and Cicchetti, 1972). In a previous Michigan State University dissertation, Jay Hughes (1964) concluded there was no "grand criterion" for solving wilderness allocation problems, but that there was a place for economics in applying a basic logic of choice. It is not my intent to push forward the frontiers of economic theory, but rather to show how some very basic economic concepts did find a place in the roadless area review and evaluation.

More important than providing some concepts for empirical calculations and comparison of areas, economic theory provided a way of thinking about the choice problem. This is probably more of a contribution than the actual empirical work which involved rather crude estimation procedures. This was the kind of application of program analysis McKean (1968, p. 129) probably meant when he said:

> Economic calculus can help by causing officials and citizens to look at problems of choice in the right way, even if all the quantities and values have to be filled in on the basis of judgement. . . . The analytical aids . . . may at least help one raise the right questions. It is hard to believe that one can make good decisions by asking the wrong questions.

In the roadless area review and evaluation, there was a desire to compare the relative "goodness" or benefits of areas as potential wildernesses with the "badness" or costs of giving up alternative goods

and services that would be produced in some type of nonwilderness management. The measures of "goodness" or "badness" would be appropriate for the program objectives.

If we view the number of acres of land devoted to the wilderness system as the primary input, we can construct theoretical total benefit and total cost curves (Figure 2). Both benefits and costs increase as

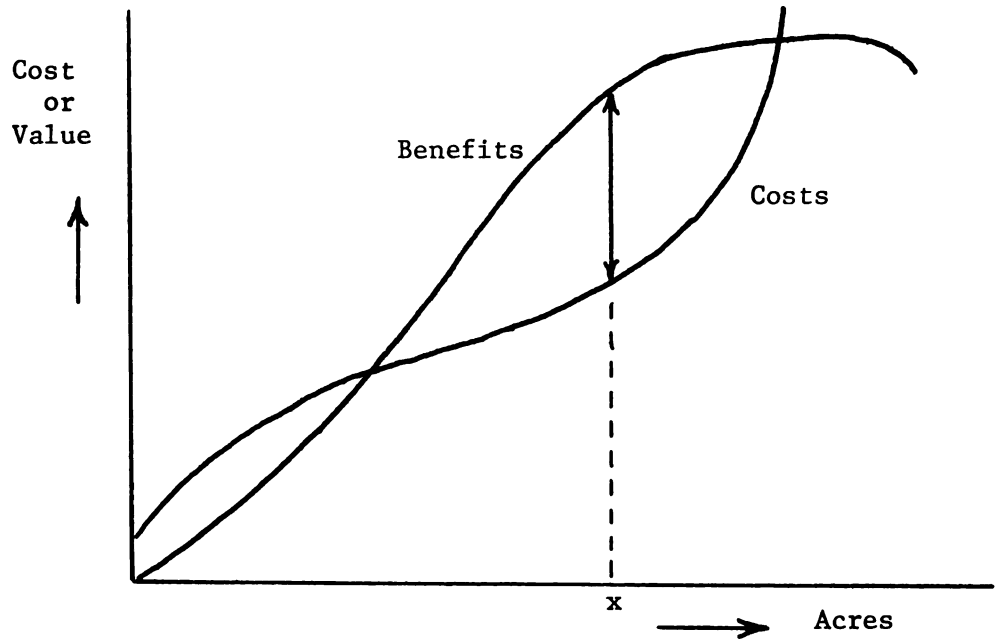


Figure 2. Theoretical total benefit and total cost curves.

the number of acres increase, and the curves reflect the law of diminishing returns. When the most beneficial acres are added first, the total benefits rise at an increasing rate. As less beneficial acres are added the total benefit continues to increase but at a decreasing rate as reflected by the change in curvature. Finally, the number of acres devoted to wilderness could reach such a scale that diseconomies

of scale could arise and total benefits would begin to decrease. Costs begin with a fixed cost, then increase at a decreasing rate, and finally increase at an increasing rate. At the extreme range, cost tends towards infinity, especially when one must contemplate the creation of "new" wilderness areas through technology. Essentially, wilderness is viewed as being impossible to create once developments such as roads or mines have been constructed.

In order to maximize welfare, the general objective would be to maximize the difference between benefits and costs. One would logically add that area where the benefit per unit cost was greatest, and continue adding areas in decreasing order of benefit per unit cost.

If both benefits and costs can be measured in the same units, then the optimum number of acres, where total benefits minus total costs is greatest ('x' acres, Figure 2), can be found. If benefits and costs cannot be measured in the same units, then the optimum cannot be determined. However, selecting areas in decreasing order of benefit per unit cost still assures that, for any given amount of acreage included in wilderness system, that total benefits minus total costs are as great as possible.

When benefits cannot be expressed in the same units as costs, but other measures can be used, then the term "effectiveness-cost," "cost-utility," or some similar term is usually used.

While costs are usually measured in monetary terms, they can also be measured in other units. Monetary costs are usually accepted to represent the marginal value of all other goods and services foregone in the production of the one desired. However, for some objectives other measures may be more desirable.

The selected indicators of effectiveness and cost should reflect the relative "goodness" and "badness" in terms of a particular program objective. Thus, effectiveness/cost criteria can be designed for a variety of program objectives by varying the measures of effectiveness or cost.

All such indicators must be recognized as proximate, and can only help sharpen the intuition of public officials.

Measures of Effectiveness and Cost

The attempts by the task force to explicity state objectives raised obvious questions such as, how do you measure wilderness values, costs, and closeness to the places where people live. In fact, one cannot really say the objectives are explicitly stated until the criteria and measures of effectiveness and cost are specified.

Effectiveness Indicators

A measure or index of "wilderness value" was needed to permit development of even proximate criteria. The nonmarket and highly political nature of the wilderness allocation problem does not readily suggest any generally acceptable measure.

One possible approach would have been to use the theory of consumer demand and attempt to define a demand function. In fact, this was attempted, but the accuracy and validity of the results were disappointing. In addition, it became evident that such values as "preservation of nature for the common good," existence values, scientific values, and the irreversibility issue created a political attitude within the Forest Service such that use and consumer demand were not particularly helpful.

Time constraints and a desire for simplicity and communicability turned the search for an effectiveness indicator toward some very simple deterministic models. Three major factors were considered:

- Size of the area
- Relative wilderness recreation quality of the area
- Proximity of area to population

Size of Area.--The total size of a roadless area was recognized as an important indicator of both the relative value of an individual area and as an indicator of the total volume, or quantity, of wilderness in a national or regional system. However, by itself, size was too stark an indicator of effectiveness.

Relative Quality of Area.--Very early in the work party's discussion it became apparent that there was a need to somehow uniformly describe the physical characteristics of roadless areas so that the relative attractiveness or desirability as potential wildernesses could be compared. Some research was available on the attitudes and desires of people who have been using the existing wilderness system. In addition, the literature contains articulations of the attributes of areas that people find satisfying.

A field rating form was devised in cooperation with the Forest Service branch of recreation planning. Three major components were rated on a 0 to 20 scale:[1]

- Scenic quality and attractiveness (S).
- Isolation and lack of evidence of man's presence (I).
- Variety of experiences available (V).

---

[1]Each component included four to five factors which were each rated and totaled.

The field officer then distributed ten weight points among the three components and calculated a total quality index (QI).

$$QI = a(S) + b(I) + c(V) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$a + b + c = 10 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

All existing wilderness and primitive areas were also rated by the same method and then ranked in decreasing order of quality index. The rankings were reviewed by Washington office staff people working in the wilderness program. They felt the rankings were intuitively reasonable, although there was no objective means for validating the quality index in the time available.

In order to make national comparisons of individual areas, the distribution of weights among the three major components were standardized. Several field officers expressed this need because the weight reflected an individual's interpretation of each component's relative importance to people rather than an assessment of the physical characteristics of the area. Therefore, the weights used in the quality index were based upon the averages of all field responses. They were:

4 - Scenic quality

3 - Isolation

3 - Variety

Proximity to Population.--The third factor introduced as a proxy for equity of distribution with reference to population was a population index. The index was intended to be a proxy for the administration's broad objective of locating recreation facilities closer to the places where people live.

The specific variable chosen was "population potential" using a gravity model computation.

$$POP_j = \Sigma \frac{P_i}{Dij} \quad (3)$$

where

POP_j = Population potential or index of roadless area j

P_i = 1970 total population of county i (Only counties within 400 miles were included)

D_{ij} = Distance in miles between county i and roadless area j

The gravity model is based on location theory, or the spatial dimension of the theory of consumer demand. The greater the distance between the user's place of residence and the roadless area, the greater his costs in terms of money, time, and forgone opportunities. Therefore, in theory, a satisfaction-maximizing individual would place a higher value on an area closer to his place of residence than on one further away, assuming the quality of the areas was identical. Also, the larger the number of people residing in a county the more visits that would be expected. The assumption is that total social value is proportional to number of probable users. The gravity model combines both factors, population and distance, into a single number which was called a population index.

One weakness is the assumption that total value is proportional to the probable number of visitors. As the number of visits rises in a given roadless area the effects of crowding may reduce the level of satisfaction to each individual. At some point on a scale of increasing use one can hypothesize that the marginal value of an extra unit of use will be zero and further use could result in a decline in total value. Fisher and Krutilla (1972) and Stankey (1972) have explored this problem, but the lack of empiracal work leaves the point moot at the present. In this

analysis the problem of capacity had to be ignored. The implicit assumption was that capacity would not constrain effectiveness. This is probably quite reasonable for the majority of roadless areas, but it may not be so reasonable for the areas very close to large metropolitan areas.

Two Indexes Used.--Two indexes of effectiveness were used.

EFF = Acres x QI ..... (4)

EFF x POP = Acres x QI x POP ..... (5)

where,

EFF = Effectiveness index of the roadless area

Acres = Total gross acres of the roadless area

QI = Quality index of the roadless area

EFF x POP = An alternative effectiveness index which reflects equity in relation to population as well as size and quality of area

POP = Population index of the roadless area by gravity model (equation 3)

The first index (EFF) provides an indicator of effectiveness unrelated to geographic population patterns. The second (EFF x POP) includes the population index which rates roadless areas closer to population centers as being more effective than more remote areas. Acreage is the basic indicator of quantity of wilderness, and the quality index (or quality index times population index) is the indicator of relative value per acre. The effectiveness indicator is similar to the common economic equation that total value product is equal to the quantity of output times the price.

The alternative effectiveness indicators were used because of an interim policy decision by the steering committee. Considerable debate arose over inclusion of the population factor. Some argued that proximity to population was an important factor. Others argued that population was a poor factor because it overemphasized the direct use of wilderness by recreationists. Preservation of nature and selection of areas where overcrowding could be more easily controlled were two primary reasons given for not including the population index in the measure of effectiveness. After debate, it was decided to use both indicators as alternatives and the issue could be resolved later by the chief and regional foresters.

Ecosystems and the Scientific Values of the Wilderness System

The Wilderness Act states that scientific and educational uses are among the purposes to which wildernesses should be devoted. Wilderness advocates frequently mention such values. For instance, the following is a quote from Michael McCloskey's "The Wilderness Act of 1964: Its background and meaning" (1966, p. 293).

> In addition to being a setting for an esthetic experience, wilderness is now regarded as an important setting for scientific research in in the biological sciences. In research on the effects of land management practices, untouched, natural plots serve as control units to compare with plots that are disturbed. Also undisturbed areas are studied to expand knowledge about complex ecosystems and little-known species. Unknown species and trace elements that prove to have commercial and medical applications continue to be found in wilderness. Finally, the complex ecosystems that develop in undisturbed areas support a genetic diversity that maximizes the possibilities of the evolutionary process. Wilderness, in effect, becomes a "gene bank" that evolution can draw upon to offset man's influence in narrowing the number of species on the planet.

Some scientific research is carried out in wilderness areas to study wilderness visitors and their characteristics and behavior. Other research focuses on the effects of visitors on the environment. Such studies provide a basis for better wilderness management. However, such research should be viewed not as a benefit of wilderness designation, but as one of the costs of management. The end benefit is still direct user value or vicarious values. Such research costs are essentially fixed costs for managing the system as a whole and should not be attributed to individual areas. Thus, they were ignored for this analysis.

Other types of research, such as hydrological studies, ecological studies, and wildlife studies are intended to improve man's ability to provide goods and services other than wilderness opportunities or to simply satisfy man's curiosity about the order of nature. There is, however, no significant research program of this kind that depends upon national forest wilderness areas. If a wilderness happens to lend itself to a certain research project and the project effects are compatible with wilderness management, then agreements can be worked out for such research. In general, the research values of wilderness may be commonly overemphasized, but there may be a value in having wildernesses for baseline studies of the structure and functioning of essentially undisturbed large ecosystems.[1]

---

[1]Based on memoranda to the author from T.F. McLintock, director of forest environment research, Forest Service, May 15, 1972, and Carl Ostrom, director of timber management research, Forest Service, May 12, 1972, (file designation 4060, Research Facilities).

About the only model the task force could suggest for maximizing research values was one that maximized the variety of ecotypes. New study areas could be selected to include a representative sample of each major ecosystem. Thus, we would have a system of "large research natural areas" to supplement the formal Research Natural Area program which generally includes areas of less than 5,000 acres.[1]

Roadless areas were classified by 40 broad ecosystems (Table 4), that were utilized in the Forest Range Environmental Study (FRES)--a national analysis of the Forest Service range management program (Forest Range Task Force, 1972). The FRES classification system was chosen primarily because it was familiar to forest officers, and classification errors would be minimized. Also, the system covered the entire United States.

Each roadless area, wilderness and primitive area was classified as to predominant ecosystem and secondary ecosystems to the nearest 1,000 acres. Certain unusual ecotypes were classified even if they covered only a small portion of the roadless area. Complete detailed ecosystem classifications were not made in each area.

---

[1]The Research Natural Area system is designed specifically to represent all or most of the ecosystems in the United States for research and educational purposes. For more information see Federal Committee on Research Natural Areas, A directory of research natural areas on Federal lands of the United States of America, (Washington, D.C.: U.S. Government Printing Office, 1968), 128.

TABLE 4.--Ecosystem classification

Name	Code	Name	Code
White-red-jack pine	10	Desert shrub	30
Spruce-fir	11	Shinnery	31
Longleaf-slashpine	12	Texas savanna	32
Loblolly-shortleaf pine	13	Southwestern shrubsteppe	33
Oak-pine	14	Chaparral-mountain shrub	34
Oak-hickory	15	Pinyon-juniper	35
Oak-gum-cypress	16	Mountain grasslands	36
Elm-ash-cottonwood	17	Mountain meadows	37
Maple-beech birch	18	Plains grasslands	38
Aspen-birch	19	Prairie	39
Douglas-fir	20	Desert grasslands	40
Ponderosa pine	21	Wet grasslands	41
Western white pine	22	Annual grasslands	42
Fir-spruce	23	Hawaiian grasslands	43
Hemlock-sitka spruce	24	Alpine	44
Larch	25	Tundra	45
Lodgepole pine	26	Muskeg	46
Redwood	27	Heath	47
Hardwoods	28	Aleutian meadows	48
Sagebrush	29	Desert	49

Cost Indicators

Total opportunity cost as used in the RARE analysis was intended to give a relative index for comparison of the economic value forgone, if a roadless area was to be designated a new study area and eventually classified as a wilderness. There were two implied general alternatives--development by man and preservation as wilderness.

Development was restricted to those opportunities which had been clearly identified, planned, and in some cases executed. The general costing assumptions were to use 1970 values and/or prices, and to discount all values to that point in time. Competitive market conditions were presumed to predominate.

The following cost components were included in total opportunity costs:

1. Timber stumpage value
2. Replacement of or compensation for special use improvements
3. Mineral right values on public land
4. Water development project net values
5. Extra land acquisition costs for private inholdings
6. Wilderness study and establishment costs
7. Additional operation and maintenance costs

Each of these cost components will be described subsequently, but it is appropriate to note here two categories of costs that were omitted and presumed zero--recreation and livestock forage. Also, unknown or unplanned future land use alternatives were not projected. Thus, the costs are expected to be slightly lower than true opportunity costs.

Recreation.--First, recreation values foregone under wilderness were presumed negligible. Undoubtedly, there are physically suitable sites in the roadless areas for many of the prohibited activities and facilities. However, mere nonutilization or nondevelopment of such sites does not constitute any loss of national benefits, although there could be slight locational diseconomies in the future. Only if there are no substitutes for such sites will there be any significant loss.

Therefore, uniqueness, or scarcity of sites is a prime factor in valuation. Certainly it is hard to argue that there is any shortage of substitute sites for developed campgrounds or picnic grounds except in very unusual local circumstances. Areas suitable for ski area development have very exacting requirements, and such sites are relatively scarce. Areas with unique features such as archeological artifacts, or historical sites have almost no substitutes and costs are more definite, except for the fact that wilderness can be managed for such uses.

All roadless areas have some amount and pattern of recreation use at present, much of which would continue under wilderness management. Of 52 possible outdoor activities recognized in national forest recreation planning, only 19 or 37 percent are prohibited in wilderness areas. Designation as wilderness would, of course, eliminate some of the users who participate in the prohibited activities. In most cases, such users would carry out the activities in another area. In other cases, users would simply substitute permitted activities for those prohibited with little loss of satisfaction. There may, of course, be some loss of satisfaction (locational diseconomies) because the quality of experience in substitute areas or activities is not as great as the quality they

would find in the wilderness or new study area. While such changes in values are real, the task force knew of no practical way to measure or approximate them. Data on existing use of each roadless area are not reported, but are lumped into "dispersed area" use of ranger districts and national forests. Procedures for isolating use estimates might be proposed, but the accuracy of such data would probably be very erratic. Analysis would not be sensitive enough to detect such subtle shifts.

The preponderence of existing use would simply continue under wilderness designation with little or no change in total benefit. Probably the greatest single dislocation would be motorized trail and overland vehicle use--trail bike use, snowmobiling, and motor boating.

There was no alternative, it was felt, but to assume that such losses in national benefit were insignificant. Where ski area proposals or other unique types of management are alternatives to wilderness, there will still be ample opportunity to analyze and compare these alternatives on a local basis before any final classification or development decisions are made.

Livestock Production Values.--Current and projected livestock production values of roadless areas would probably not be significantly affected by designation of areas as new study areas or wilderness because of Section 4, d(4)(2) of the Wilderness Act which makes special provision for the "grazing of livestock, where established prior to the effective date of this Act, shall be permitted to continue subject to such reasonable regulations as are deemed necessary by the Secretary of Agriculture."

Perhaps the regulations for management of new study areas or wildernesses would increase the livestock production costs. However, since the roadless areas are already relatively remote, it is difficult to anticipate any major differences. Prohibition of helicopter landings and motor vehicle use might have some minor effect. Rustic design standards for range improvements might raise costs over those normally incurred. The evidence was rather intuitive, but it seemed that such effects were not great enough to cause significant reductions in livestock production efficiency.

Unlike the timber situation, the aggregate livestock effects of any list of new study areas will not significantly affect national livestock prices. The contribution of national forests to livestock production makes up only 4 to 5 percent of total national production. The maximum total impact on national output would probably be much less than 1 percent, even if all 1,448 roadless areas were made new study areas.

Therefore, livestock production values were not included in total opportunity costs of roadless areas. It was recognized, of course, that there may be some local effects that should be considered as individual new study areas are studied in detail. Some of these lands have an important seasonal complementary function of filling out an annual cycle of cow-calf or ewe-lamb operations. In some cases, restriction of range improvement programs might limit expansion for some ranchers.

Timber Values.--Classification of a roadless area as wilderness would preclude the harvest of timber and, hence, the value of the annual allowable harvest contributed by the area would be a significant opportunity cost. In order to compute such opportunity cost the following information was submitted by field officers for each roadless

area.

1. Estimated annual allowable harvest in board feet local scale.
2. Estimated permanent road mileage and construction costs for permanent roads needed to harvest and develop the area.

The following model was used to estimate the net present worth of timber output under current and past intensitites of management.

$$TV = a(P+RD-MC)\ (AAH) - b\left(\frac{RDCOST}{30} \times CFL/ACRE\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

where,

TV = Timber value of roadless area in net present worth (thousands of dollars)

a = Present worth discount factor for perpetual series at 5 percent (20.000).

P = Average experienced high bid stumpage price for the national forest in which roadless area located for FY 1969-71 period.

RD = Average system and road development costs per unit timber harvest for national forest in which roadless area located.

MC = Management costs per unit timber harvest for Forest Service region in which roadless area located.

AAH = Estimated annual allowable timber harvest of roadless area in thousands of board feet local scale.

b = Present worth discount factor for 30 years at 7 percent (12.40904).

RDCOST = Estimated road construction costs for the roadless area under similar type of management as experienced in recent past. The construction costs were divided by 30 years to estimate average annual cost, corresponding to the approximate period of time before all roadless areas could be developed.

CFL/ACRE - Proportion of roadless area occupied by commercial forest land (growth potential > 20 cubic feet per year).

Average regional road costs were added to stumpage prices and then actual estimated road costs were subtracted under the assumption that the cost of roading the remaining areas may be higher, or at least different, than recently experienced road costs. Generally those areas which have not yet been roaded tend to be more costly to road.

A 7 percent discount factor was used as an estimate of the approximate cost of capital. The 7 percent rate is recommended in the latest version of proposed Water Resources Council land and water planning standards (U.S. Water Resources Council, 1971).

A 5 percent discount rate was used for factor 'a' to reflect an estimated 2 percent per year increase in the real prices of timber stumpage related to the prices of all other goods and services. This assumption was recommended by the Forest Service division of timber management and the division of forest economics and marketing research based upon historical price trends and their demand and supply projections.

The road construction costs were reduced by the proportion of commercial forest land acres to gross acres on the assumption that the difference would be attributable to other road benefits such as recreation.

Since maintenance of roads is a normal cost component of timber harvesting such costs are reflected in the stumpage prices used. It was assumed that such implied road maintenance cost would perpetuate roads without periodic reconstruction.

Mineral Values.--The mining and utilization of mineral deposits, known or unknown, may be influenced by the designation of new study areas, and the probability of eventual wilderness classification.

Valuation was complicated by the fact that the Wilderness Act makes special provision for mining. Mining can be carried on under the general mining laws on all wilderness areas where private rights are established before December 31, 1983. On January 1, 1984, all mineral rights in wilderness areas, except those private rights already established, will be withdrawn from appropriation. No mining rights can be established on wilderness areas after that date.

Thus, with designation as new study area or even as wilderness, mineral extraction legally need not be foregone. The costs of extraction will be higher than normal, because of the higher than average restoration and environmental protection standards, and because of expected litigation costs to assert and defend mining rights.

We can assume that those areas inventoried as unroaded have no significant active mining. Mining usually requires roads. From an economic standpoint, it seems likely that with existing knowledge any known mineral deposits in roadless areas have a lower current net value than any actively mined deposits. Otherwise, they would be active. From a national standpoint, the current opportunity cost of completely foregoing mining at the present time must be near zero in most of the roadless areas.

However, as currently active deposits are depleted, the marginal value of undeveloped deposits in roadless areas will likely rise. Minerals are a "stock" or nonrenewable resource. The future values may well be positive, for some mineral deposits, in some roadless areas.

Technological advances, especially mineral recyclying technology, may partially offset depletion.

Information on the existence, amount, or quality of mineral deposits is very poor; at least it is very spotty. The information on valuation is even poorer. The costs of identifying areas with mineral potential are very high.

Therefore, mineral values were included in total opportunity costs only if the mineral deposit was known and a market value of the mineral rights could reasonably be estimated by regional land appraisal and mineral experts. The mineral value was roughly estimated at the current market value of mineral rights (as if the rights were privately owned and traded in an open market). Such estimates were available for very few roadless areas.

Special Use Values.--At the request of the task force, field officers reported the estimated replacement value of existing special use improvements that would have to be removed if the roadless area were eventually to be designated as wilderness. These included such things as cabins, power lines, radar sites, and similar features that were not significant enough to consider the area "developed," but would be incompatible with wilderness. The estimated replacement values were included in total opportunity costs without further adjustment. Proposed or possible future land occupancies such as power transmission lines and highways were not projected.

Water Development Project Net Values.--While water development projects such as canals and dams can be permitted in wilderness areas by Presidental approval, the assumption for this analysis was that new study area designation would likely preclude such development. Political pressures would limit any development, even if there were legal means to obtain construction approval.

The net present worth of projects already planned and studied were included in total opportunity costs. Field offices determined whether or not benefit/cost analyses were available. If analyses were available they reported the "annual net benefits" as normally used in U.S. Army Corps of Engineer river basin reports.

To make such values comparable, net present worth was calculated by discounting a 50-year stream of net annual benefits at a 7 percent discount rate. Fifty years is the maximum planning horizon normally used in water development planning, and the 7 percent rate is recommended in the latest U.S. Water Resources Council standards (1971).

There was concern on the task force that perhaps such opportunity costs were overstatements of true values foregone, particularly in view of a recent evaluation of actual water investment performance reported by Haveman (1971). However, there was no feasible way to review, challenge, or correct these estimates. Therefore, they were presumed accurate, and included. There were only 16 roadless areas where water development project values were involved.

Land Acquisition Costs.--Wilderness areas, primitive areas, and roadless areas include some private lands, referred to as "inholdings." It is Forest Service policy to place all wilderness or primitive area inholdings in acquisition priority I (highest priority). Therefore, the effect of new study area status will be to shift all priority II and III inholdings (lower priorities) to priority I. Past funding has been sufficient only to acquire some of the priority I lands.

The following data were submitted by field offices:

1. Acres of private inholdings (PI) within each roadless area by:
   a. Current acquisition priority I, highest priority for acquisition (A_I).
   b. Current acquisition priority II or III, lower priorities generally not acquired under past and expected future levels of funding (A_{II}).
2. Land acquisition cost estimate for all private inholdings (C_l).
3. Mineral right acquisition cost estimate for all private inholdings (C_m).

The private land and mineral acquisition costs of roadless areas were adjusted to reflect the extra or marginal costs of new study area or wilderness designation. It was assumed there will be no extra cost if lands are already priority I. However, extra costs will be involved when inholdings are shifted from priorities II and III to priority I. It was assumed that funds would be made available by directing them from other Federal uses and there would be an extra opportunity cost.

The following model was used to calculate the land and mineral acquisition cost (LAC) that was included in the total opportunity cost of each roadless area:

$$LAC = \left(\frac{PI - A_I}{PI}\right)(C_l + C_m) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

Establishment Costs.--Classification of an area as wilderness requires a significant investment for studies, mapping, hearings, and classification action by Congress. The Forest Service division of recreation, based on their experience with primitive area reviews, estimated such costs as follows:

$1/acre for Forest Service study, review, and classification.

$1/acre for U.S. Geological Survey mineral studies as required by the Wilderness Act.

$2/acre total

Operation and Maintenance Costs.--Wilderness classification also increases the operation, maintenance, and law enforcement costs of administering the areas. The division of recreation estimated the annual cost of administering, cleaning up, and maintaining wilderness areas and primitive areas at $1.50 per visitor day or 50¢ per acre per year. Allowing an estimated 10¢ per acre per year for existing operation and maintenance with no special status, gave a net cost of 40¢ per acre per year.

Discounting this annual cost as a perpetual series at 7 percent gave a present value cost per acre of $5.71 which was rounded to $6 per acre.

Analysis Criteria

The development of explicit analytical criteria lies at the heart of any program analysis. Criteria are simply "rules of choice" for choosing among alternatives, and there are a great variety of criteria that can be used in any given problem. The criteria should be designed to help identify those alternatives that best achieve a specific objective. Thus, a different criterion is required for each program objective.

Criteria may be very simple or they can be quite complex. In the RARE analysis two general types of criteria were used--constraints and ranking criteria.

Constraints are "satisfying" conditions that must be met. Alternatives either meet the condition, or they do not. Mathematically, constraints are inequalities, such as "if 'a' is greater than 'C' then the alternative is acceptable; otherwise it is not." A common program analysis criterion of this nature is that benefits must exceed costs for an alternative to be acceptable. Constraints can also be complex--there may be several conditions that must all be met, or there may be several optional conditions any one of which makes an alternative acceptable. Constraints help separate, or group, alternatives into acceptable/unacceptable categories but, within a category, they do not indicate which alternatives are better than others.

Ranking criteria, however, are used to show the relative desirability of alternatives in meeting a specified objective. There are no absolute conditions that must be met. Instead, the alternatives are arrayed along a continuum from good to bad. There are three general types of ranking criteria commonly used in program analysis--maximizing

criteria, minimizing criteria, or optimizing criteria. For instance, alternatives could be ranked so as to maximize effectiveness. Or, they could be ranked to minimize costs. However, it is never possible to simultaneously maximize effectiveness and minimize costs with one ranking. Therefore, optimizing criteria are often more desirable. An optimizing criterion of maximizing the difference between benefits and costs (benefits minus costs) might be used if both benefits and costs can be measured in the same units. This, of course, was not possible in the RARE analysis. The very commonly used optimizing criterion of ranking alternatives in order of effectiveness/cost ratio was used in the RARE analysis.

The development of criteria by the task force was a continual process, because the program objectives were not clear and explicit at the beginning of the analysis. Criteria were proposed, critiqued, and revised in an iterative manner up to an including the line officer decisionmaking session in December 1972 which will be discussed in the final chapter. The steering committee was the primary sounding board for developing criteria, but researchers and regional forest officers were involved in many of the discussions.

At one point a series of effectiveness/cost rankings were proposed corresponding to what the analysts believed were the objectives of each of several interest groups involved. However, this was a rather complex set of criteria, and a regional forester strongly challenged the criteria because they really didn't help him find a solution that approached "the public interest."

The task force then asked an economic analysis consultant, Dr. Robert Manthy, Michigan State University, to review and critique the study plan. He recommended that the task force use a relatively simple three-stage screening process utilizing constraint type criteria rather than ranking criteria. The constraints would utilize the same basic data and measures of effectiveness and cost previously discussed.

This general approach was adopted by the steering committee, and it seemed to clarify and simplify the analysis considerably. The specific constraints underwent considerable revision, and some ranking criteria were reintroduced into the analysis by the work party.

The resulting analysis which was presented to the chief and regional foresters divided the 1,448 roadless areas into three groups or lists. The lists were color coded in the traditional traffic light pattern for communication purposes.

Green List - Those areas meeting any one of seven specific constraints intended to identify the very highest priority areas that should be new study areas.

Red List - Those areas meeting any one of four specific constraints designed to identify the least desirable areas.

Yellow List - Those areas of intermediate desirability, that were in neither the red nor green lists, were ranked by five alternative effectiveness/cost indicators that corresponded to the five alternative program objectives.

All 1,448 areas were subjected to both the red and green screening criteria (Figure 3), and those remaining were then ranked by the five ranking criteria. It was theoretically possible for an area to fall out in both the green and red lists, and if this occurred the area would have been placed in the yellow lists. However, no area actually met the criteria for both lists.

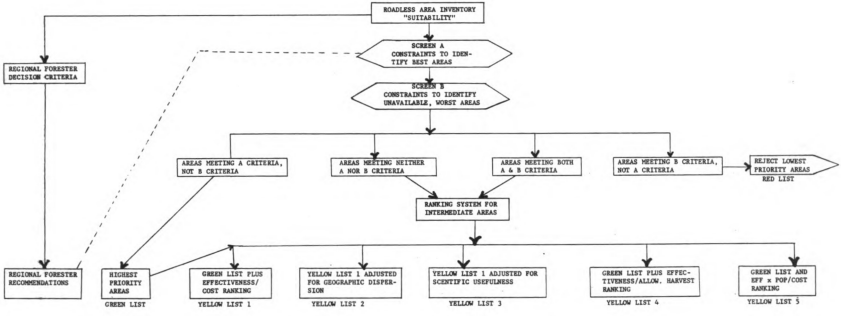


Figure 3.--Task force evaluation procedure

The Green List Criteria

The first level of screening of inventoried areas was intended to provide a tentative "base" number of roadless areas that could be viewed as so outstandingly suitable that there would be little disagreement or controversy that they should be new study areas. In some cases, commitments for such studies had already been made.

The task force felt that the regional foresters' tentative recommendations should weigh heavily in these screening constraints, although this opinion was not unanimous. Those dissenting argued that the criteria used by regional foresters might not be explicit, and from a national viewpoint might be difficult to defend. The primary supporting reason was that regional foresters were more sensitive to local issues and factors not included in the national analysis such as political realities, local economic displacements, trnnsportation systems, boundary adjustment problems, and similar complexities. Undoubtedly, a desire for internal harmony strengthened the desire to avoid radical departures from line officers' recommendations.

An area meeting any one of the following constraints was placed on the green list:

1. Already designated as new study area.
2. Recommended by a regional forester and public involvement "class 1" (general uniform support for study).
3. Recommended by a regional forester and quality index greater than 155 (upper quartile of the quality indexes of all recommended areas).
4. Recommended by a regional forester and contiguous to an established wilderness or primitive area.

5. Contiguous to a primitive area and is now or will be studied in connection with a primitive area review required by the Wilderness Act.
6. Areas with ecotypes that are relatively uncommon in the national forest system (redwood, shinnery, Texas savanna, wet grasslands, annual grasslands, Hawaiian grasslands, tundra, muskeg, heath, Aleutian meadows, and desert).
7. All areas in the East (southern and eastern regions) and Puerto Rico because of very low supply of unroaded and undeveloped areas and very high demand for wilderness.
8. Areas with very unique characteristics that obviously make the area highly desirable for a new study area.

Constraints #1 and #5 are "predefined" new study areas. Constraint #2 reflects those situations where political or administrative conflict appeared absent. Constraint #3 is an arbitrary quality index constraint that included the best quality areas recommended by regional foresters. Constraint #4 recognized the difficulty of assessing local boundary adjustment problems that would be very difficult if not impossible to systematically analyze on a national basis. Constraint #6 was a preservation related constraint that would include areas representative of very uncommon ecotypes where substitute areas are very few; national scientific and education values would be protected from irreversible development until in-depth studies could be completed. Constraint #7 was premised on the fact that 85 percent of the U.S. population and

hence most demand, is in the East, while only four areas or 5 percent of the wilderness system acreage is in the East. Constraint #8 allowed for consideration of special factors or unforeseen factors that were not reflected in the quality index or included in constraint #6.

To provide for the identification of special factors, field officers briefly identified special or unique features about the areas. Several hundred features were identified. In reviewing these features for significance the work party found many general terms such as "scenic mountains" or "geologic" to be of little value or redundant with quality index factors. In many cases, it was unclear whether the features would be better managed under wilderness or some alternative type of land management.

Therefore, a team of interdisciplinary specialists which included a wildlife specialist, a landscape architect, a watershed specialist, and a recreational planning specialist was assembled. This team boiled the list of special features down to only a very few that they felt might merit some special consideration as new study areas because of the special features. The areas were:

Area Name	Region	Special Features
Salmo-Priest	Northern	Mountain Caribou
Capitan Mountain	Southwest	Active rock glaciers
Sheep Mountain	California	Big horn sheep
Cactus Springs	California	Desert big horn sheep
Cooks Comb	California	Arizona trout and Kaibab squirrel

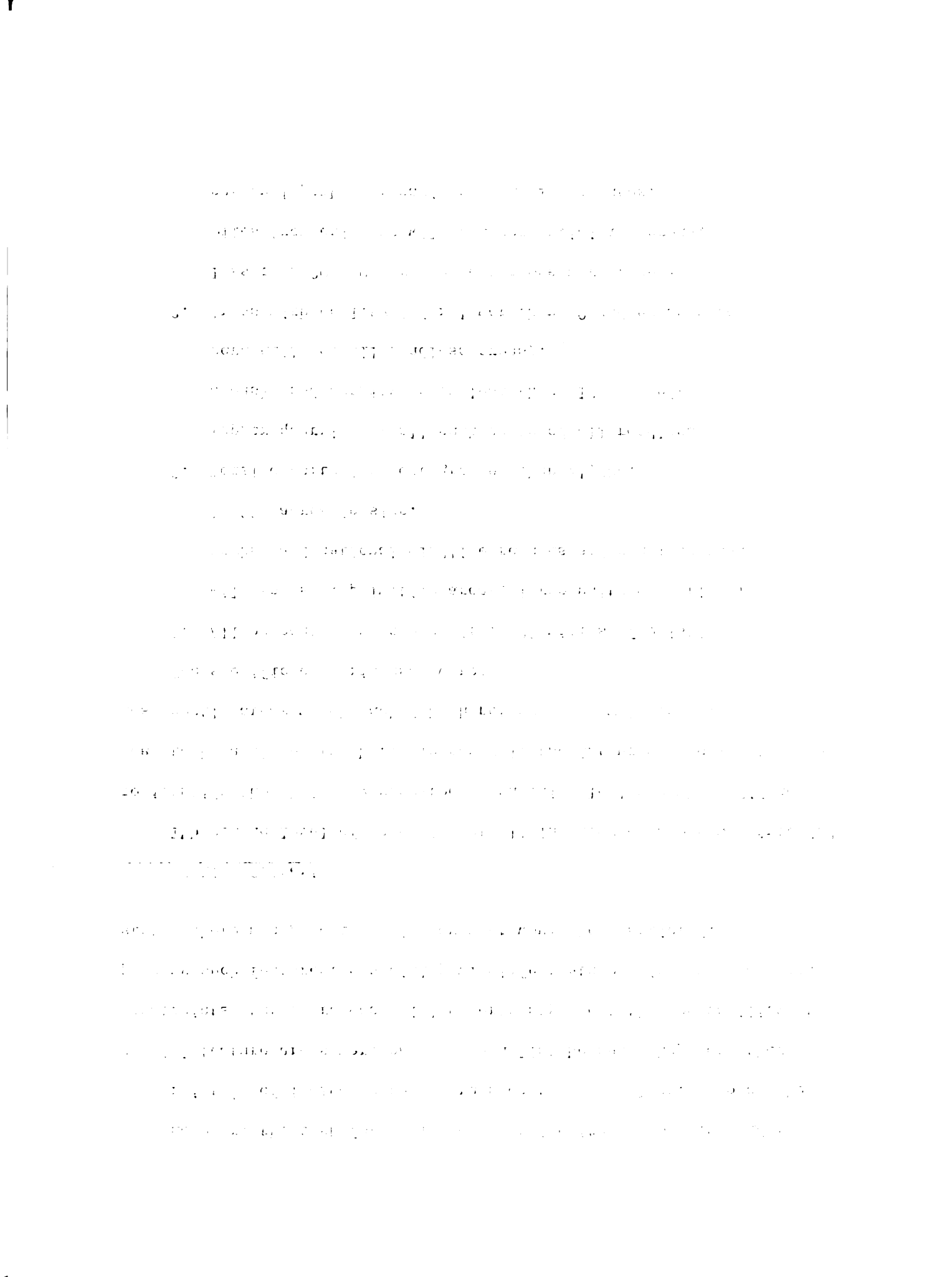
However, the task force did not exercise its prerogative under constraint #8 of including these areas on the green list. Two of the special feature areas were on the green list because they met other constraints, but there was still uncertainty about the desirability of placing such features, especially wildlife features, in new study area status where management and improvement would be restricted.

The Red List Criteria

The second level of screening of all inventoried areas was intended to identify the obviously unsuited or unavailable lands which did not need to be analyzed further. In general, the intent was to identify the most costly areas which lacked high potential as wilderness.

The specific criteria used were:

1. All noncontiguous areas within 25 milles of existing wildernesses, primitive areas, large units of national parks, and national wildlife refuges and are less than 10,000 acres in size.
2. Total opportunity cost greater than $1,000,000 (upper quartile of all such costs of all roadless areas), and quality index less than 110 (the 66th percentile of all roadless areas).
3. Areas with quality index lower than 80 and gross area less than 30,000 acres except those more than 100 miles from existing wildernesses, primitive areas, national parks, or national wildlife refuges.



4. Areas with a commitment to nonwilderness land use through June 30, 1973, that will reduce the area suitable for wilderness to less than 5,000 acres (Alaska was a special case and was not included in this criteria).

The first criterion was intended to drop out small areas that were near existing wilderness or potential wildernesses that provided substitutes. The basis was that demand in the general area could be adequately served by the existing system.

The second criterion was intended to identify the very highest cost areas, using an arbitrary upper quartile cutoff point. However, because large areas tend to be better wildernesses as well as more costly a quality index ceiling was included.

The third criterion was aimed at small, low quality areas.

The last criterion was included to omit areas where existing administrative commitments made wilderness consideration infeasible. This constraint was related to a court suit by the Sierra Club against the Secretary of Agriculture during the course of the analysis. The criterion was consistant with the court's ruling that legal commitments made prior to June 30, 1973, would be exempt from the court's requirement for an environment statement before development of any roadless area could precede.

Yellow List Rankings

Those areas which met neither the red nor green list criteria were ranked in descending priority using five alternative models or criteria corresponding to the five alternative objectives.

Effectiveness/cost ratios were chosen as the basic technique and the ratios were modified or constrained to reflect the alternative program objectives (Table 5).

TABLE 5.--Criteria used in yellow lists

Alternative Program Objective	Ranking Criteria	Modifications or Constraints
1. Maximize net social value	Effectiveness/cost	None
2. Geographic dispersion	Effectiveness/cost	Omit all areas within 100 miles of wildernesses, primitive areas, national parks, and national wildlife refuges.
3. Ecosystem representation	Effectiveness/cost	Must include as many ecosystems as possible in highest ranked areas.
4. Minimum timber impact	Effectiveness/ allowable timber harvest	None
5. Population proximity	Effectiveness x population/cost	None

Basic Effectiveness/Cost.--Ranking of the areas by effectiveness/cost ratio was intended to emphasize the "efficiency" objective of obtaining the most wilderness value (effectiveness) relative to the costs and value of foregone opportunities to provide other goods and services for society (total opportunity costs). As previously discussed, the underlying theory is production economics where marginal benefits, in this case marginal effectiveness, and marginal costs are compared.

Geographic Dispersion.--With the objective in mind of more evenly distributing the wilderness system over the United States, all areas within 100 miles of existing wilderness or primitive areas, national parks or national wildlife refuges are omitted from the effectiveness/cost ranking.

A computerized model called "POP" was utilized which computed the distance between the roadless area and all wildernesses, primitive areas, national parks, and national wildlife refuges.[1] The distance was computed in miles based on straight line distance between the two areas. Each area was identified by a single point of latitude and longitude. The acreages of all wildernesses, primitive areas, national parks, national wildlife refuges within 100 miles were accumulated, and, if greater than 5,000 acres, the roadless area was dropped from the effectiveness/cost ranking.

---

[1]Some national parks and wildlife refuges were not included. Only those identified by the Department of Interior as requiring review under the Wilderness Act of 1964 were included.

The resulting list identified those areas which could fill in the "spatial gaps" in the system, although it appeared that the existing wildernesses, primitive areas, national parks, and wildlife refuges are rather evenly distributed over the western United States. The great bulk of roadless areas are within 100 miles of such areas. Earlier in the analysis a 200-mile radius was contemplated, but there are no roadless areas in the West more than 200 miles from an existing area.

Ecosystem Representation.--The third alternative criterion was intended to provide a list of areas that represented as many of the identified ecosystems as possible.

The procedure was as follows:

Step 1. All ecosystems that were represented by at least 5,000 acres in an existing national forest wilderness or primitive area were identified (14 ecosystems).

Step 2. All ecosystems that were similarly represented by a roadless area on the green list were identified (15 additional ecosystems of which two included less than 5,000 acres of the ecosystem).

Step 3. All ecotypes not represented by 5,000 acres or more in areas resulting from either step 1 or step 2 were identified (13 ecosystems).

Step 4. All roadless areas containing any of these 13 unrepresented ecosystems were listed, and areas to represent the ecosystem were selected on the basis of the highest effectiveness/cost ratio.

TABLE 6.--Ecosystems representation summary

Name	Code	Total in National Forest System	Total in existing Wilderness and Primitive Areas	Total in Inventoried Roadless Areas		Green List		Priority areas to be placed at top of effectiveness/cost ranking, Criterion 3.	
		M Acres	M Acres	Number of Areas	M Acres	Number of Areas	Total M Acres	Area Number	M Acres
White-red-jack pine	10	1498	250	0	0	--	--		
Spruce-fir	11	2175	402	17	136	3	43.0		
Longleaf-slashpine	12	1135		1	10	1	1.0		
Loblolly-shortleaf pine	13	3623		0	0	--	--	none	
Oak-pine	14	2221		1	14	--	--	none	
Oak-hickory	15	6832		0	11	1	11.0		
Oak-gum-cypress	16	470		2	213	1	12.0		
Elm-ash-cottonwood	17	290		0		--		none	
Maple-beech birch	18	2695	2	0	0.3	1	0.3		
Aspen-birch	19	2354	350	2	18				
Douglas-fir	20	20211	812	438	4807	31	4396.6		
Ponderosa pine	21	19214	564	129	2044	20	188.4		
Western white pine	22	3467		33	534	1	30.0		
Fir-spruce	23	18392	3467	519	5346	83	1071.4		
Hemlock-Sitka spruce	24	2294		5	211	2	121.1		
Larch	25	3259		34	196	--	--	208-1	32.0
Lodgepole pine	26	13527	1387	411	470	28	503.4		
Redwood (R)	27	7		0	0	--	--		
Hardwoods	28	6785	88	128	1066	14	108.1		
Sagebrush	29	10002	30	148	2107	8	143.2		
Desert shrub	30	4989		17	233	1	22.3		
Southern (R)	31	81		0	0	--	--	none	
Texas Savanna (R)	32	5		0	0	--	--	none	
Southwestern shrubsteppe	33	1068		7	63	3	29.5		
Chaparral-mountain shrub	34	6740	516	134	1248	7	39.0		
Pinyon-juniper	35	10230	381	111	994	11	140.8		
Mountain grasslands	36	7154	153	141	1188	13	64.0		
Mountain meadows	37	1921	52	41	48	5	29.0		
Plains grasslands	38	3564		11	43	--	--	none	
Prairie	39	253		0	0	--	--	none	
Desert grasslands	40	1196		2	4	--	--	none	
Wet grasslands (R)	41	25		1	20	1	20.0		
Annual grasslands (R)	42	--		13	95	3	19.0		
Hawaiian grasslands	43	--		0	0	--	--	none	
Alpine	44	8288	1736	226	3730	51	1328.8		
Tundra (R)	45	--		1	1	1	1.0		
Marine (R)	46	--		2	18	2	18.0		
Beach (R)	47	--		0	0	--	--	none	
Alkaline Meadows (R)	48	--		0	0	--	--	none	
Desert (R)	49	--		3	6	2	5.0		
Subtropical-low mountain	50	--		1	8	1	8.5		
Pleistocene pine (R)	51	--		1	5	1	5.0		
Foothill pine (R)	52	--		1	15	1	15.0		

(R) Indicates type is relatively uncommon in the National Forests (less than 100,00 acres).

However, 12 of the ecosystems could not be found in any roadless area, so only one additional ecosystem could be represented by this yellow list criterion.

Step 5. The single area resulting from step 4 was placed at the top of the effectiveness/cost ranking of yellow list areas. Thus, as many ecosystems as possible were represented by the existing system, the green list, and the first area on the yellow list.

An attempt was made to obtain data on ecosystems represented by national parks and wildlife refuges, but the Department of Interior was unable to furnish data in the time available. Some of the unrepresented ecosystems may well be represented in other potential wilderness areas administered by the Department of Interior.

Effectiveness/Allowable Harvest.--The fourth alternative criterion of ranking the yellow list areas by effectiveness/allowable harvest was intended to emphasize the alternative social objective of obtaining the greatest wilderness value with minimal impact on the total allowable timber harvest of the national forest system.

The measure of effectiveness was the same as that used in the first ranking, effectiveness/cost, but allowable harvest was substituted for total opportunity cost in the denominator. This criteria had the effect of drawing the higher ranked areas toward the nontimbered or less heavily timbered regions of the West.

Effectiveness x Population/Cost.--The fifth and last alternative criterion was intended to emphasize the alternative program objective of locating potential wildernesses relatively closer to the places where people live while still recognizing the quality and size of areas and their relative costs to the Nation.

The numerator used was effectiveness x population (equation 5) and the denominator was total opportunity cost as previously defined. This ranking criterion tended to draw the higher ranked yellow list areas toward the population centers of the West.

Data Processing

To compile and manipulate data on 1,448 alternative roadless areas in the brief time available, automated data processing was required. For over five years the Forest Service, through project "INFORM," (Information Management) had been developing a generalized electronic data processing system to meet a very wide array of data collection and retreival problems. This centralized data processing system was to be the backbone of a modernized management system that would facilitate multifunctional planning and decisionmaking.

The system had not yet been implemented on operational programs, but the task force turned to project INFORM for assistance. The roadless area review and evaluation study provided a valuable test ground to see if the computer software could be successfully used in a "firing line" situation.

The data bank, containing 82 items on each of the 1,448 roadless areas, was successfully (but painfully) processed using the Generalized Information Management (GIM) system, one component of INFORM. Once the data was stored, nonprogrammers such as the author could list and sort the data using English-like statements. New variables could be generated within the GIM system in order to compute the indicators of effectiveness and cost as previously described. Areas that met specific criteria could be listed. Up to eight simultaneous constraints could be imposed on the data bank. Areas could be sorted by the various ranking criteria. In addition, selected areas could be electronically plotted on a United States base map using the Geographic Locator (GELO) component of project INFORM.

A work plan and schedule (Figure 4) was developed to define the critical path. The key time constraint was the decision point in December 1972, and this target date was set in a political context independent of the critical path study plan. Timeliness is a vital element in successful program analyses. Analyses must be responsive to policymakers' time constraints if they are to be effective. Tension over time targets was a very real problem, and there were slippages within the schedule. However, the final time targets were met. Special detailers, contracts, overtime work, and premium computer rates were all required at times in order to accomplish the job on time. A mandate from the chief asking all units to give full cooperation to the task force was a very vital element in resolving the many production and logistical problems.

Field data were retreived in two stages. Prior to formation of the task force in April 1972, directives had been sent to the field requesting the basic inventory acreages and certain timber data. However, the form of reporting was vague, and the first effort undertaken was to develop a uniform reporting format. It was decided in April 1972 that no new information could be requested by June 30, 1972, so the first form RARE-1, Preliminary Data, provided only very basic inventory data on location, acreage, and timber volumes. These data were key punched and stored in the GIM system.

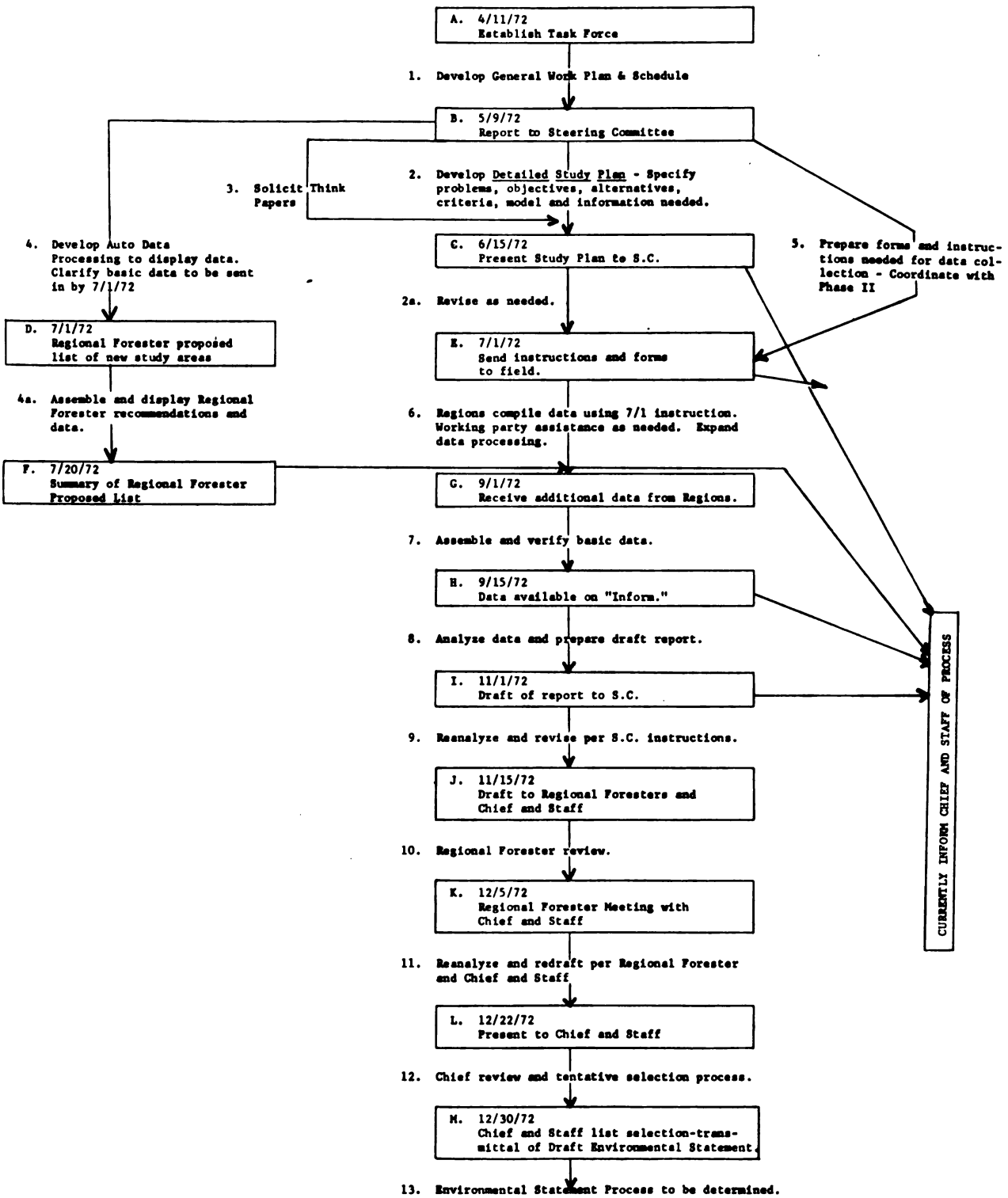


Figure 4.--General work plan and schedule.

Then, following development of a preliminary study plan which was presented and approved by the steering committee, specific field data requests were formulated into a series of field compilation forms.

RARE-2 A three-part summary form for recording data from forms RARE-3 to 9. This form was the only one submitted to the Washington office and was used for key punching data.

RARE-3 A five-page form with instructions for rating of quality index.

RARE-4 Ecosystem and special feature worksheet

RARE-5 Land acquisition costs worksheet

RARE-6 Mineral value worksheet

RARE-7 Water development projects

RARE-8 Special land uses report worksheet

RARE-9 Timber road cost worksheet

The seven worksheets were used so that data compilation could be simultaneously handled by several functional divisions or specialists. Washington office functional divisions provided consultation on design of the forms and instructions so that field office compilation would be as accurate and efficient as possible. The summary form, RARE-2 was compiled by each region and sent to the Washington office for key punching and storage in the GIM system.

Maps submitted by regions were electonically digitized by the division of engineering's geometronics development division. The source maps varied greatly in scale, but once digitized, the scale could be mathematically adjusted and the areas could all be located on a common scale United States base map. A common identifying number was used to link the tabular data in the GIM system with the geographic data stored in the GELO system.

V. RESULTS OF ANALYSIS

This chapter summarizes the results of the RARE analysis described in the previous chapter. All 1,448 roadless areas were analyzed.

These results are described approximately as they were presented to the chief and regional foresters at a meeting held in December 1972. The data is identical to that reported by the Forest Service (1973) in a draft environmental statement filed in January 1973. Data changes made after January 1973 are not reflected.

Green List

A total of 201 areas were identified as meeting one or more of the green list criteria. Of these, 61 were already under study. The 201 areas contained 9.7 million acres and the allowable timber harvest impact was about 250 million board feet per year (Table 7). The cumulative effectiveness index was 10.7 million[1] as contrasted to 25 million for the existing national forest wilderness and primitive areas (88 areas). The opportunity costs of the green list totaled about 250 million dollars.

The areas were distributed rather uniformly over the western United States (Table 7 and Figure 5). Of the western regions, the California region had the fewest roadless areas, although they now have more wilderness and primitive areas than any other region. The Rocky Mountain region had the largest number of areas, but many of them were already under study in connection with primitive area reviews.

---

[1]The units of measure were not named, but could be called "acre-quals" or some similar term. Effectiveness is equal to (acres x quality index) ÷ 100.

TABLE 7.--Summary of green list by regions

Regions	Northern	Rocky Mountain	Southwestern	Intermountain	California	Pacific NW	Southern	Alaska	ITF[a]	Totals
Total effectiveness index (thousands)[b]	1,971	2,544	580	3,171	823	1,276	40	264	10	10,679
Total opportunity cost ($ millions)	37	31	21	38	23	51	.6	21	.07	223
Total allowable harvest year (millions bd. ft.)	54	37	44	19	20	60	0.4	11	--	245
Total acres (thousands)	1,588	1,818	411	1,912	516	812	37	2,567	8	9,669
Total number of areas	35	57	24	40	17	19	2	6	1	201
Number recommended by regional foresters	21	25	24	36	16	16	1	2	1	142
Number under study (AOS)						10		4		14
Number under study with primitive areas (APS)	13	32			2					47

[a]Institute of Tropical Forestry, Puerto Rico

[b]Cumulative (acres x quality index) ÷ 100,000.

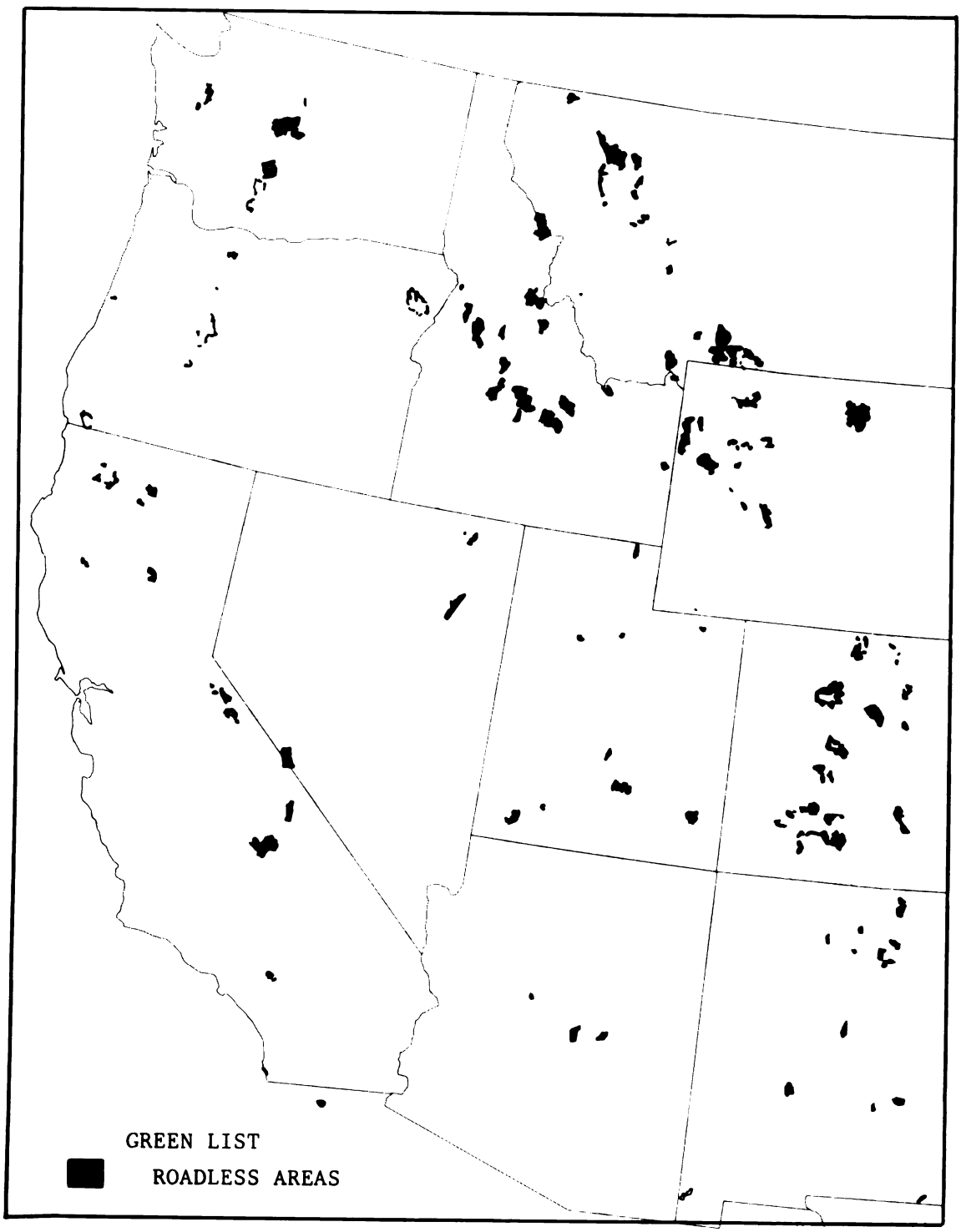


Figure 5.--Map of green list areas.

The green list contained 139 of the 182 areas recommended by the regional foresters. Thus, over three-fourths of the regional foresters' tentatively recommended areas were identified as being very high priority study areas, and only one fourth of their recommended areas were scrutinized further.

Red List

The red list, designed to identify the least desirable roadless areas, contained 315 areas or 22 percent of the 1,448 roadless areas inventoried.

These 315 areas contained only six million acres or 11 percent of the inventoried acreage (Table 8). Thus, the red list areas tended to be smaller than average as expected from the criteria described in the previous chapter.

The areas were comparatively ineffective as potential wildernesses as measured by the cumulative effectiveness index of 4.7 million--about 11 percent of the total effectiveness of all inventoried areas.

The red list had a proportionately high opportunity cost--$809 million dollars or 31 percent of the total cost of the entire inventory of roadless areas. The high cost was due primarily to the heavy allowable timber harvest on these areas--one half billion board feet or 23 percent of the allowable harvest of all roadless areas. As expected, these areas tended to be concentrated in the Pacific Northwest and the northern Rockies (Figure 6).

None of the red list areas were recommended by regional foresters, and none had general public support for new study area status (public involvement code 1).

TABLE 8.--Red list summary by region

Regions	Northern	Rocky Mountain	Southwestern	Intermountain	California	Pacific NW	Southern	Alaska	Totals
Total effectiveness index (thousands)	1,305	407	084	1,216	348	1,434			4,794
Total opportunity cost index ($ thousands)	110	197	12	181	49	260			809
Allowable timber harvest/ year (million bd. ft.)	112	17	1	20	54	331			535
Total acres (thousands)	1,584	504	83	1,330	400	1,795			5,696
Number of areas	64	40	8	45	25	133	0	0	315
Number recommended by regional foresters	0	0	0	0	0	0	0	0	0

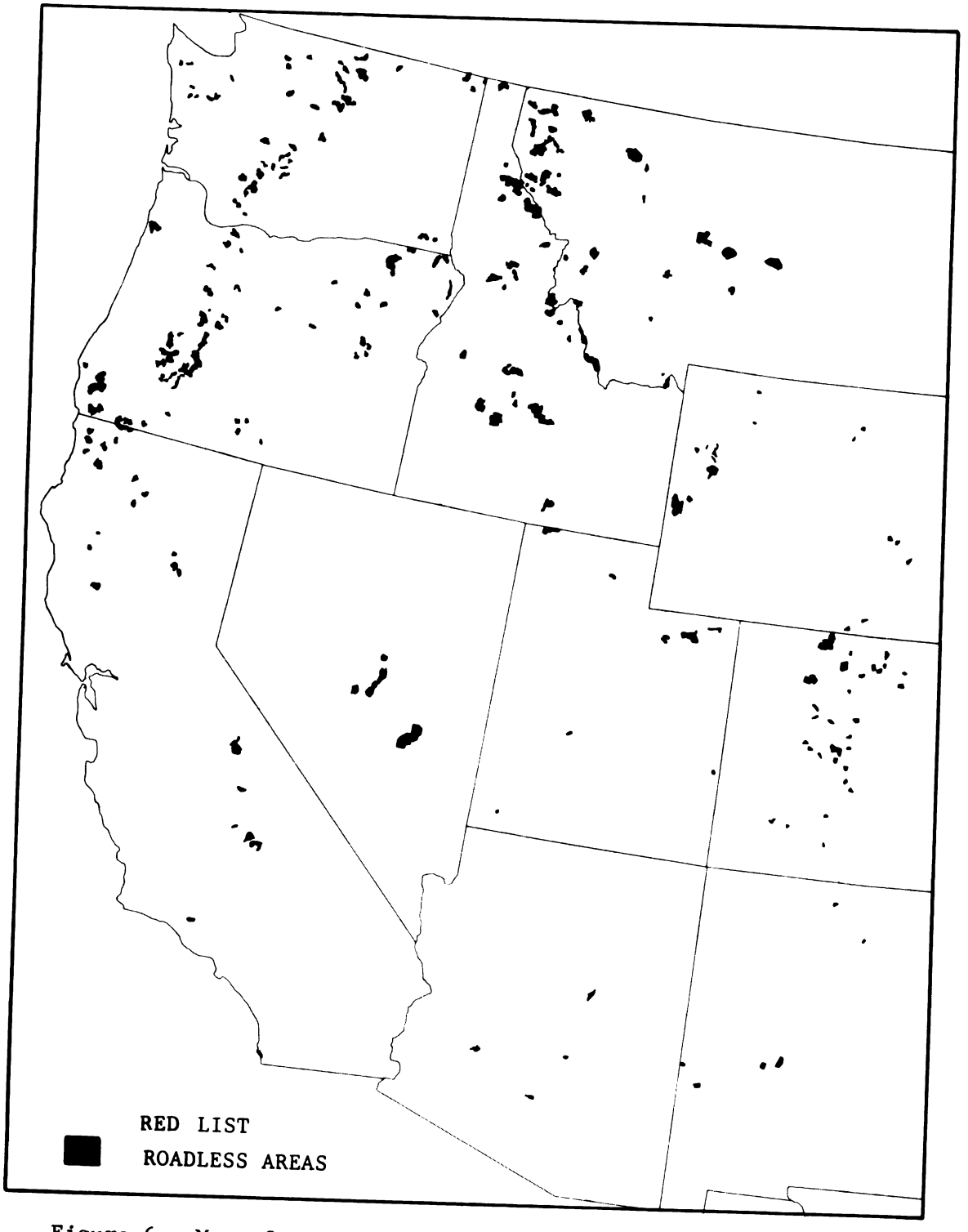


Figure 6.--Map of red list areas.

Yellow Lists - Areas of Intermediate Desirability

Those areas meeting neither the red nor green list constraints (932 areas) were ranked according to the five alternative criteria described in the previous chapter. The rankings were intended as a decision aid to add areas to the green list. Each of the five yellow lists was viewed as an alternative priority list. In this section, the rankings are each discussed and then compared to one another at an arbitrary 15-million acre "size-of-list" point. Finally, the cumulative effects of the green, yellow, and red lists are graphically displayed.

Criterion 1 - Effectiveness/Cost

Ranking of areas by effectiveness/cost ratio emphasized the objective of obtaining the most wilderness value relative to the costs and value of forgone opportunities to provide other goods and services for society.

The higher ranked areas on yellow list #1 tended to be located in the less heavily timbered regions in the intermountain west. To display the spatial distribution pattern the top 189 areas were plotted, by computer, on a United States map (Figure 7). These areas, containing 5.3 million acres, when added to the green list, gave a total acreage of 15 million acres. The 15 million acre list was simply an arbitrary point for display purposes.

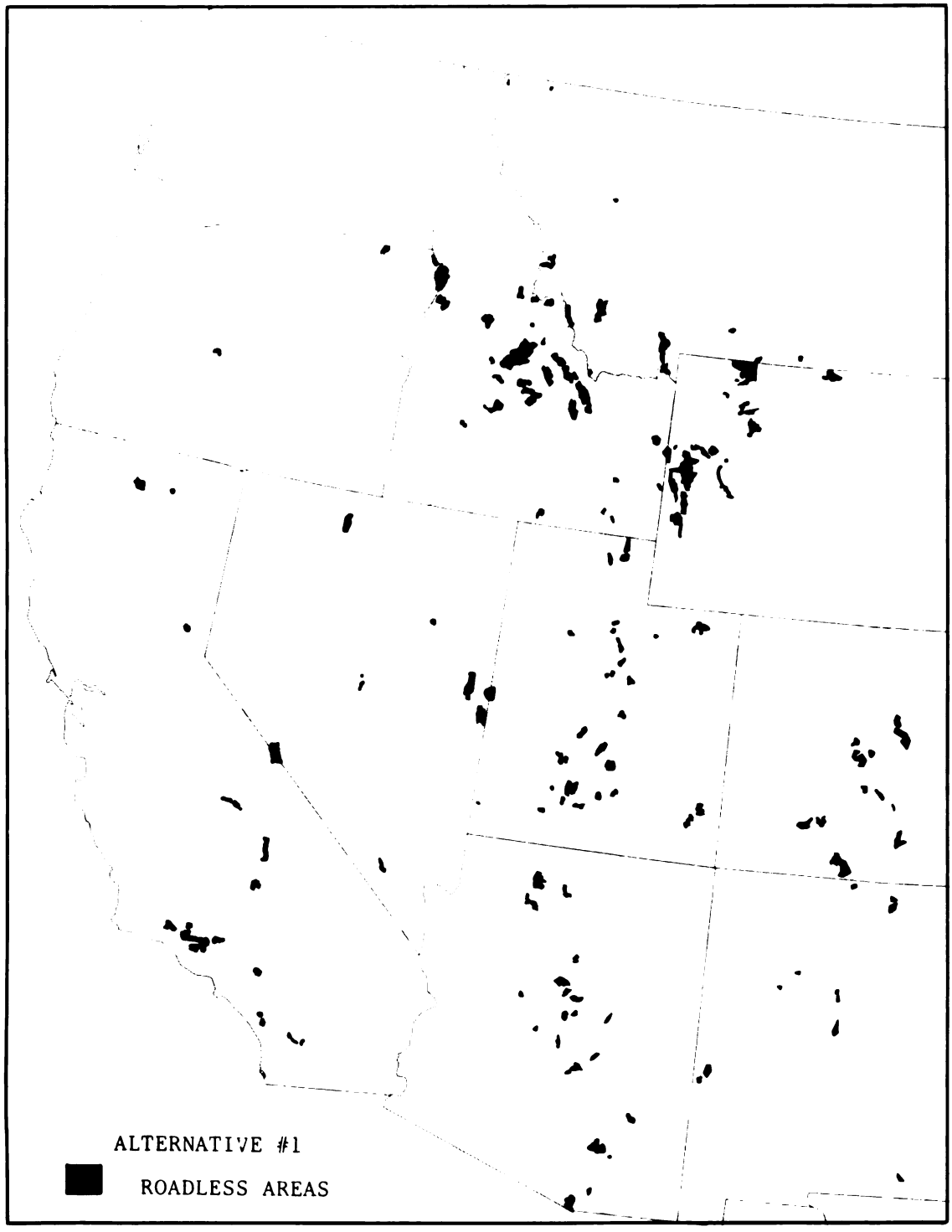


Figure 7.--Map of first 189 yellow list areas ranked by effectiveness/ cost criterion.

Criterion 2 - Geographic Dispersion

With the objective in mind of more evenly distributing the wilderness system over the United States, all areas within 100 miles of existing wilderness or primitive areas, national parks, or national wildlife refuges were deleted from the effectiveness/cost ranking.

Surprisingly, only 30 areas remained in the ranking. These 30 areas were located in Nevada, the Oregon coast, and near the Canadian border (Figure 8).

Thus, there are very few opportunities for improving the geographic distribution of the wilderness system due to the rather uniform distribution pattern of existing wildernesses, primitive areas, national parks, and national wildlife refuges. The distribution is constrained by the location of national forests. There are major areas in the Midwest and East with no wilderness areas and only three inventoried roadless areas.

The 25 areas contain 300,000 acres, and have total effectiveness index of 1.3 million. The annual allowable timber harvest on these areas is 21 million board feet, and the estimated opportunity cost is $10 million dollars.

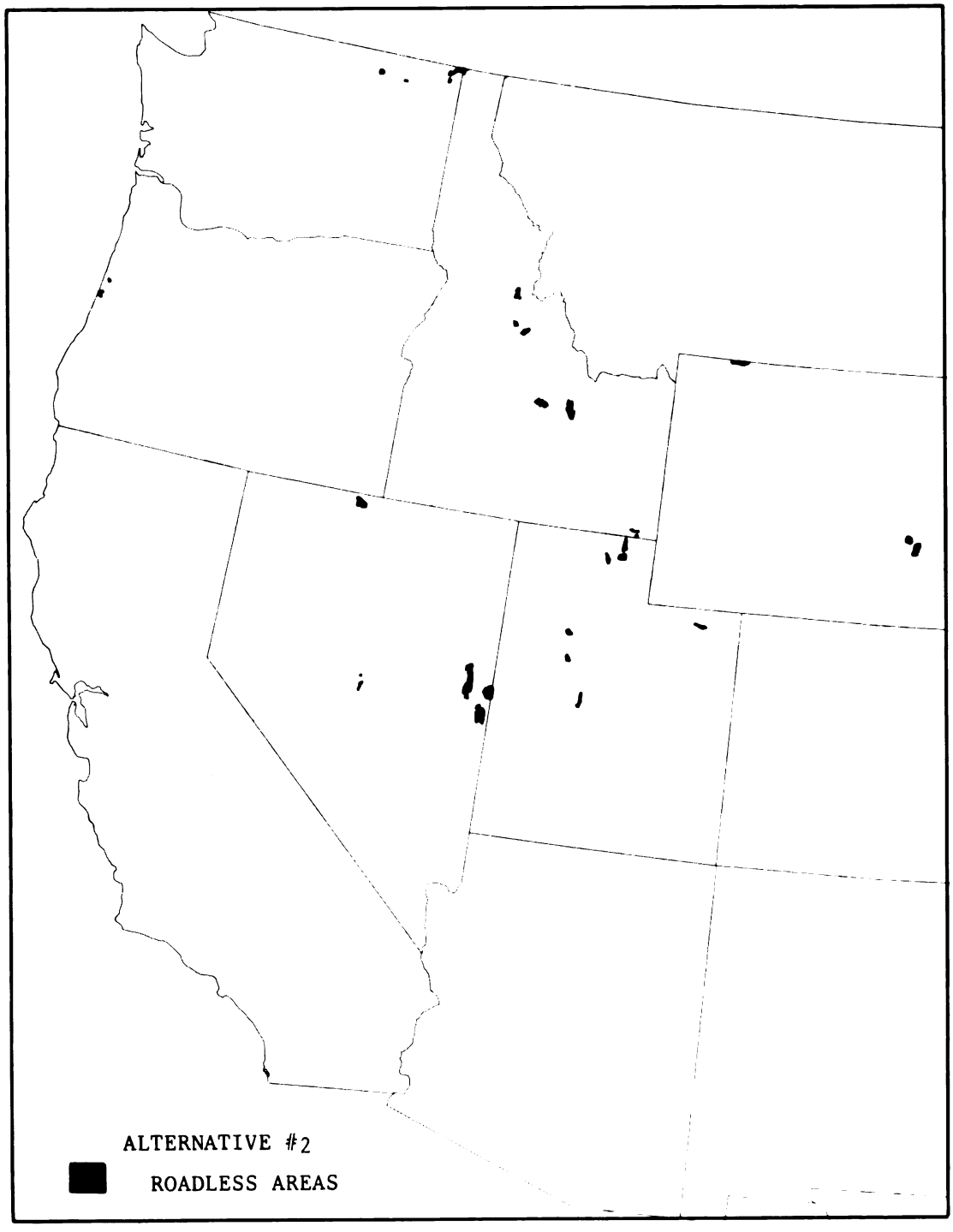


Figure 8.--Map of areas located more than 100 miles from existing wildernesses, primitive areas, national parks, and national refuges.

Criterion 3 - Ecosystem Representation

To help achieve the scientific and educational purposes of wilderness by maximizing the variety of ecosystems, the basic effectiveness/cost ranking (criterion 1) was altered by placing roadless areas containing "unrepresented" ecosystems at the very top of the ranking. The procedure was described in the previous section.

Existing wilderness and primitive areas contain at least 5,000 acres of 14 different ecosystems (Table 6). An additional 13 ecosystems were represented by at least 5,000 acres of the green list, including seven ecosystems considered rare or unusually scarce in the national forest system. Three of these unusual ecosystems--subtropical, bristlecone pine, and foxtail pine--were added to the basic 40 ecosystems used in the forest range environmental study (Forest Range Task Force, 1972). These types were added at the request of field officers because of the uniqueness of these particular ecosystems.

An additional 11 ecosystems of the possible 43 could not be found anywhere in the roadless area inventory. Four ecosystems--longleaf-slashpine, maple-beech-birch, redwood, and tundra--were represented by less than 5,000 acres in either the existing wilderness system or in the green list. Additional acreages of these four ecosystems were not identified in the roadless area inventory. This left only one ecosystem--larch--to be represented in yellow list #3. One area, containing 32,000 acres of the larch ecosystem, was selected to represent the ecosystem. Area #208, Thompson River, in region 1 was selected because it had the highest effectiveness/cost ratio among the several roadless areas containing the larch ecosystem. In addition, the work party recommended one other ecosystem--hemlock-sitka spruce--be represented in the lower 48 states. The type was represented only in Alaska. Area 501, Tomyhai

Silesia, was selected. These two areas were moved to the top of the effectiveness/cost ranking to make up yellow list #3. Otherwise, this third alternative ranking is identical to yellow list #1, the first alternative ranking.

Criterion 4 - Effectiveness/Allowable Timber Harvest

The 932 yellow list areas were also ranked by the ratio of effectiveness divided by annual allowable timber harvest volume.

Roadless areas with zero allowable harvest have an infinite ratio. Therefore, these areas were ranked by effectiveness alone.

Areas with a positive allowable harvest effect then followed the 226 nontimbered areas in the effectiveness/allowable harvest ranking (Figure 9). This provided a ranked list of areas that could be added to the green list, so as to minimize allowable harvest impacts. If this ranking (yellow list #4) had been used, the green list could have been expanded from 201 areas to 427 areas with no increase above the one-fourth billion board feet in the green list.

A map showing the first 219 areas containing 5.3 million acres was plotted with the GELO system (Figure 10). These areas, when added to the green list, gave a total acreage of 15 million acres. The spatial pattern is similar to the map prepared for criterion 1, except there is a heavier concentration of areas in southern California and the Southwest.

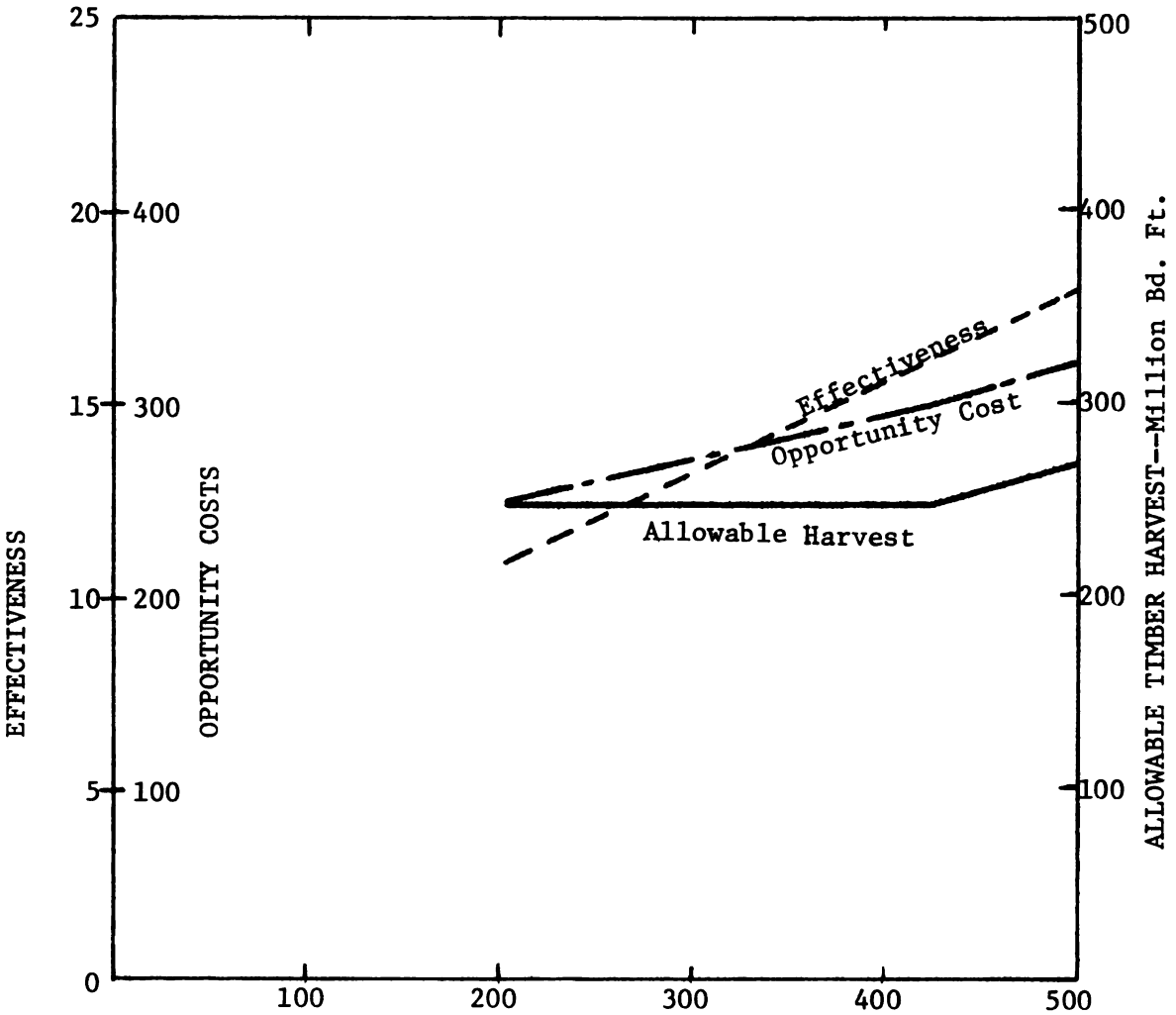


Figure 9.--Effectiveness, opportunity cost, and allowable timber harvest related to cumulative number of areas for alternative ranking criterion #4, effectiveness/allowable harvest.

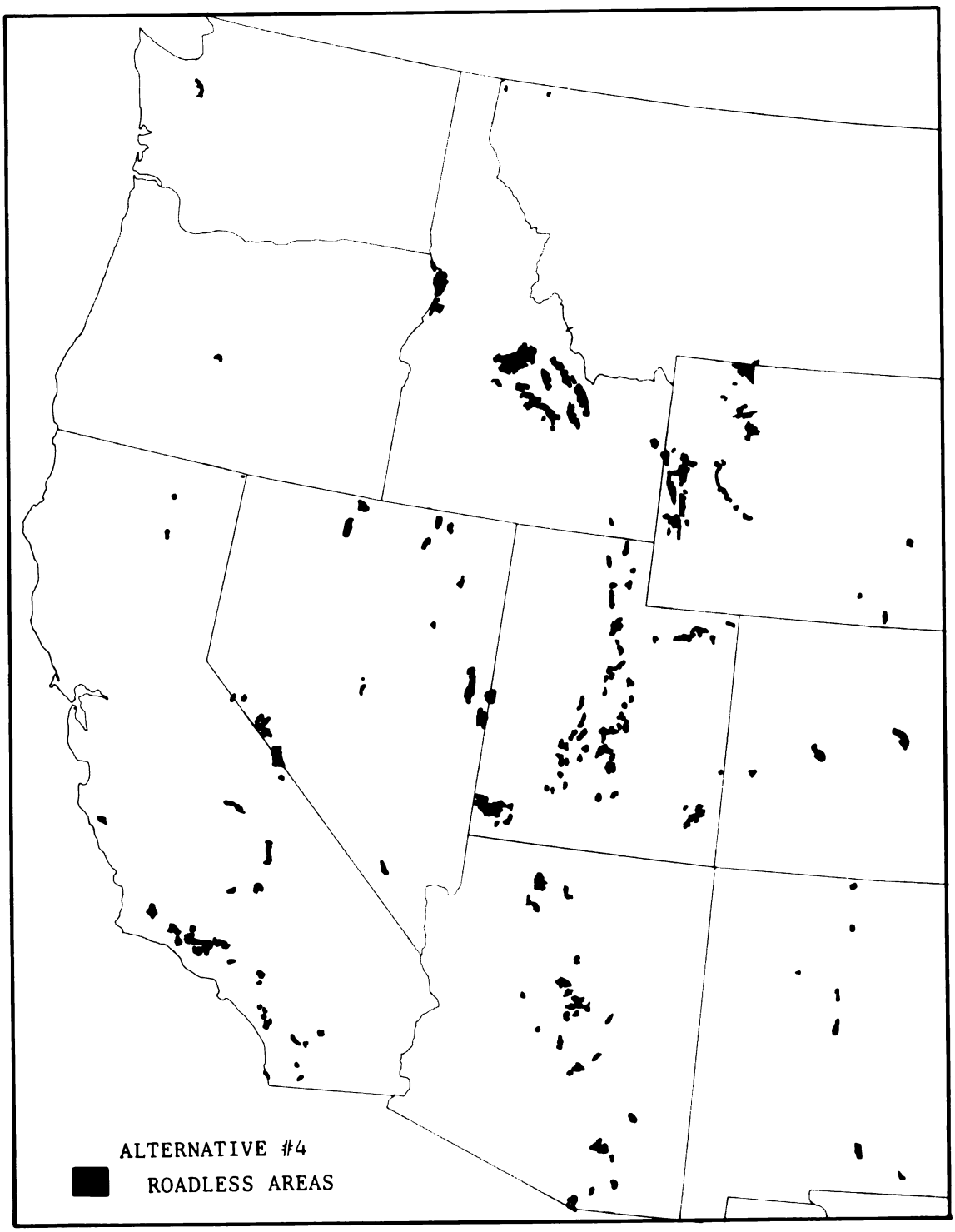


Figure 10.--Map of first 219 yellow list areas ranked by the effectiveness/allowable timber harvest criterion.

Criterion 5 - Effectiveness x Population/Cost

The fifth criterion for ranking the 932 yellow list areas included a "population proximity" indicator with the basic effectiveness/cost criteria. The criterion was explained in the previous chapter.

Since effectiveness/cost was a major part of the criterion, the geographic pattern was similar to that for criterion 1, except the higher ranked areas in this case were skewed toward southern California (Los Angeles metropolitan influence), Denver, Salt Lake City, and other urban centers of the West. A map was plotted showing the top 197 areas (Figure 11). These areas, containing 5.3 million acres, when added to the 9.7 million acres in the green list give a total of 15 million acres.

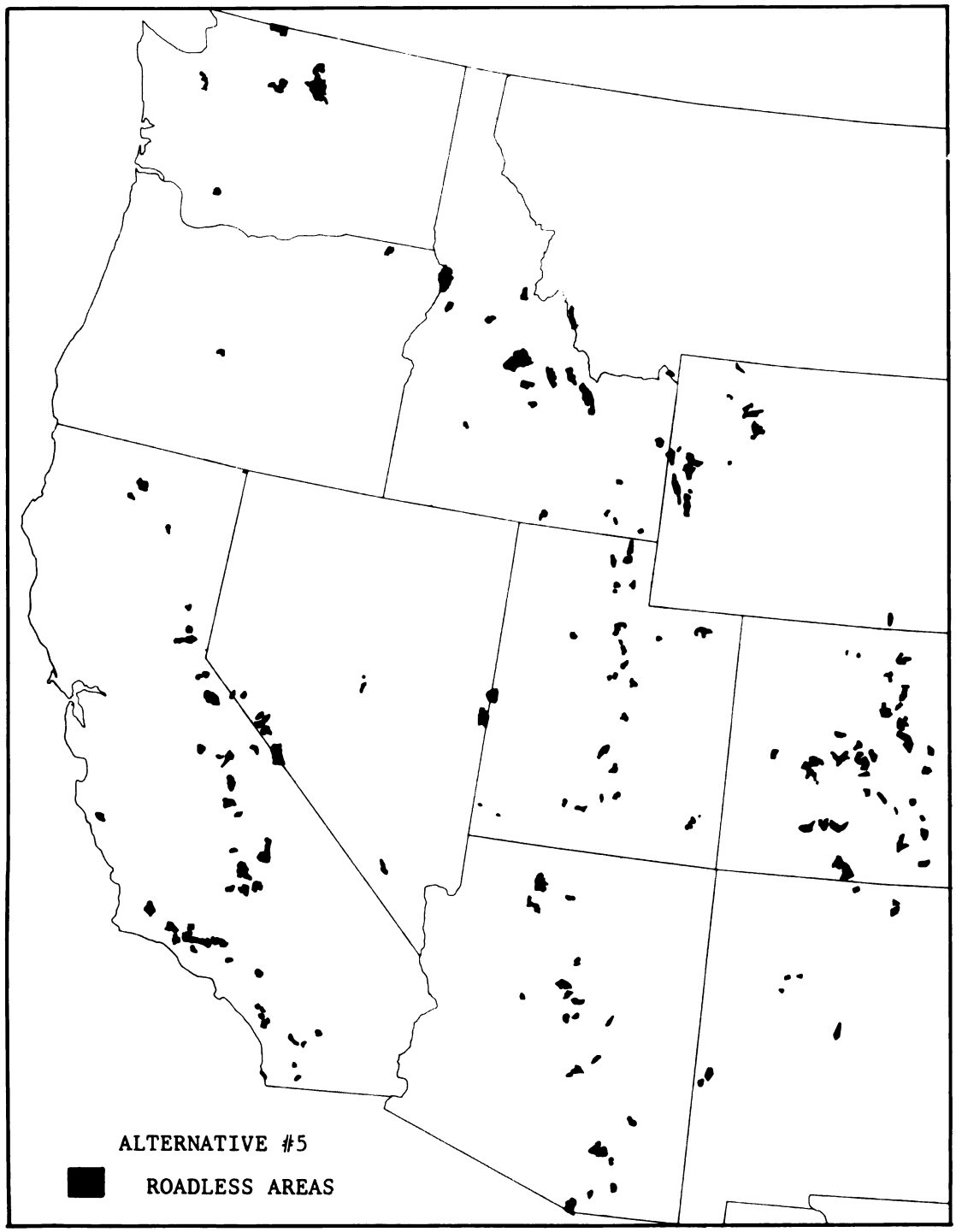


Figure 11.--Map of first 197 yellow list areas ranked by the effectiveness x population/cost criterion.

Comparison of Alternative Criteria

The five ranking criteria were compared with one another to provide decisionmakers with additional information to help them choose among the ranking criteria. The key factors that the task force felt would be helpful were total effectiveness, cost, allowable timber harvest, number of areas, acreage, and consistancy with regional foresters' recommendations.

In order to compare the rankings in such a multifactor problem, it was necessary to hold one of the variables constant for each alternative. The task force deliberated the question of which factors to use, given the time and resources available. The task force felt that acreage and, to a much lesser extent, allowable harvest impact were the two most important factors that decisionmakers would use in visualizing the alternatives of scale.

An arbitrary total acreage point of 15 million acres was selected to compare the five criteria.[1] For each alternative criterion enough areas were added to the green list in order of decreasing priority to bring the total acreage to 15 million acres. Then the cumulative totals for the other decision factors were compiled for all roadless areas making up the 15 million acres (Table 9). Because criterion 2 (geographic dispersion) permitted only 25 areas to be added to the green list, the second alternative does not approach the 15-million acre comparison point.

---

[1]The task force developed comparisons at two other total acreage points and three total allowable harvest points. However, all pointed to similar conclusions, and a single comparison is presented here in the interests of simplicity.

TABLE 9.--Comparison of alternative ranking criteria

Decision Factors	Green List	Existing National Forest Wilderness System	Alternative Ranking Criteria				
			EFF/COST 1	GEOG. 2	ECO 3	EFF/AAH 4	EFF x POP/COST 5
Cumulative effectiveness index (millions)	10.7	25	18	12	18	16	17
Total opportunity costs (millions)	223		269	233	274	267	297
Number of ecosystems represented	28	14	-	-	30	-	-
Cumulative allowable timber harvest million board feet	245		274	266	281	249	299
Total number of areas	201	89	390	231	391	420	398
Total number of areas recommended by regional foresters	142		167	146	167	162	162
Total acres (millions)	9.7	15	15	10	15	15	15

The conclusions drawn from this comparison are:

- Criterion 1 (EFF/COST) or criterion 3 (ecosystem) yield the greatest cumulative effectiveness.
- Criterion 2 (geographic dispersion) has the least cost and the least effectiveness, because only 25 areas are added to the green list. Since only 10 million acres are included this criterion is not comparable to the other four.
- Criterion 4 (EFF/ACC) has the next least cost and the least allowable timber harvest impact. However, it also is the second least effective. Criterion 4 has the largest number of areas indicating that the average size of areas is less than that for the other alternative criterion.
- Criterion 5 (EFF x POP/COST) is slightly less effective than criterion 1, but it must be remembered that the areas are located much closer to urban centers. The cost is higher than any of the other alternatives. The high cost is due to inclusion of more west coast areas with slightly higher allowable harvest effects and substantially higher timber prices. Transportation advantages, foreign competition, high timber quality, and higher timber growth rates are the major factors causing generally higher opportunity costs for areas located nearer the west coast (California, Washington, and Oregon) population centers.

It was also of interest to note that the existing national forest wilderness and primitive area system is very effective as measured by the effectiveness index. The 15 million acres of roadless areas are approximately equal to the acreage of the existing system, yet the effectiveness index of the existing wilderness system is 67 percent greater than the roadless areas. It takes about 25 million acres of roadless areas to equal the cumulative effectiveness index of the existing system.

How Much?

A major issue in the roadless area review was how much wilderness is enough. The question was largely a political one, since wildernesses have been treated as public goods rather than as market goods or services. However, political decisions should be based upon policymakers' judgement of what best represents the public interest. Indicators of national benefits, costs, and effects can be very useful, even in the most political issues.

In most public land resource allocations the benefits and costs are usually redistributed, especially when there are no user fees or the fees are less than the opportunity costs. Those who benefit may not bear the costs, or at least they may not bear costs in proportion to the benefits they might obtain. There are "winners" and "losers." These "redistribution of wealth" questions often form the basis for the most heated political controversies. The RARE analysis did not address these issues directly, but it seems highly unlikely that any "redistribution" analysis would provide new information to the line decisionmakers. Public involvement activities and the daily activities of these men in the political arena provide them with a finely tuned political intuition.

However, the RARE analysis did provide some tools for assessing the national program effects. Displaying the total national effects was one of the primary reasons for undertaking the roadless area review and evaluation. In the past, as many individual areas were debated in the political process, there was no way to see the cumulative effects of several independent decisions. Such a procedure tended to be a "random walk" to some unknown cumulative effect. The RARE analysis provided the tools to display these cumulative effects for numerous alternative mixes of areas.

The important decision factors which were made available by the analysis were:

- Total effectiveness index
- Total opportunity costs
- Total allowable harvest impact
- Total acres
- Total number of areas

Graphs were prepared to show how the cumulative totals of these decision factors changed as the total acreage that might be included in the new study area list increased. Charts were prepared for each of the five alternative ranking criteria.

In each case the minimum starting point was the 9.7 million acres included in the green list. Then cumulative totals were shown in descending priority for the given ranking criteria. Finally, the red list areas were added as a group.

These charts were intended to provide a basis for line officers to make a policy judgement on the approximate total size of list desired. Costs and effects of alternative sizes of lists would be readily known.

The task force felt that line officers should first decide on a tentative national size of list before deciding which areas should be studied and which should not.

Cumulative Effects Under Criterion 1

The cumulative effects under criterion 1, (effectiveness/cost) are depicted in the following two graphs (Figures 12 and 13). The most obvious relationship is that both effectiveness and cost increase as acreage increases, but at different rates. This was expected based upon the economic theory discussed in Chapter IV.

Effectiveness increases in almost a straight line relationship to acreage. The abrupt "flattening" of the effectiveness curve between 35 and 50 million acres is because no quality index rating was given to the single roadless area in Alaska containing 18 million acres.

Total opportunity costs displayed an increasing cost curve. Costs rose very little as the size of list was expanded beyond the green list and up to 15 million acres. Costs rose moderately up to 25 million acres and sharply after 25 million acres. Adding the six million acres of red list areas greatly increased total costs.

The second chart (Figure 13) shows how the number of areas and the volume of allowable timber harvest changes as the acreage increases. The number of areas increases in proportion to size of system except for a flattening between 35 and 40 million acres due to the 18-million acre area in Alaska. The green list contains 201 areas and one-quarter billion board feet of annual allowable timber harvest. The cumulative timber harvest increases slowly as the size of list is expanded to 15 million acres; it increases at an increasing rate beyond that point. The red list has a large allowable cut impact--one-half billion board feet on less than six million acres.

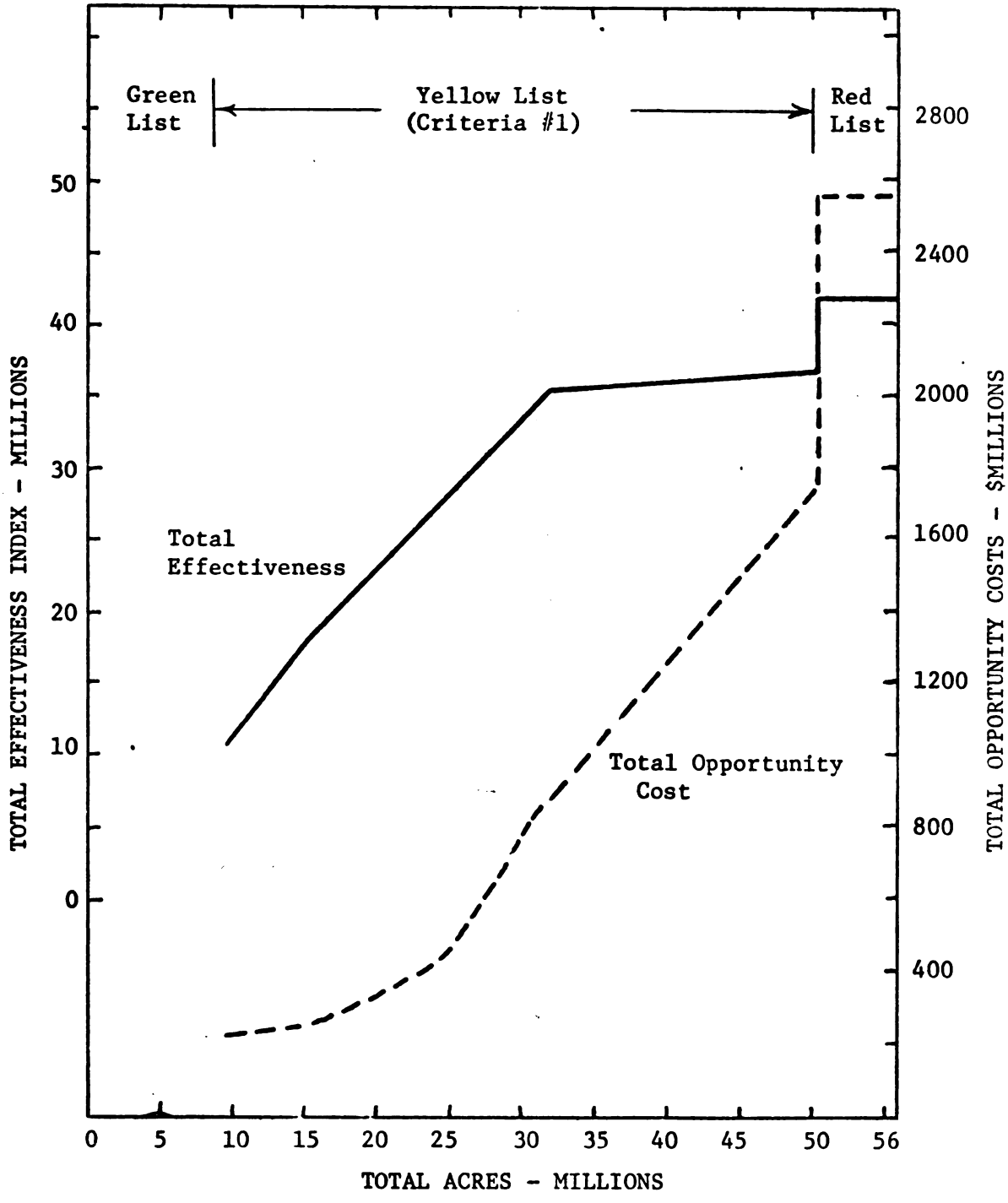


Figure 12.--Cumulative effectiveness and opportunity costs related to size--alternative criterion #1--effectiveness/cost.

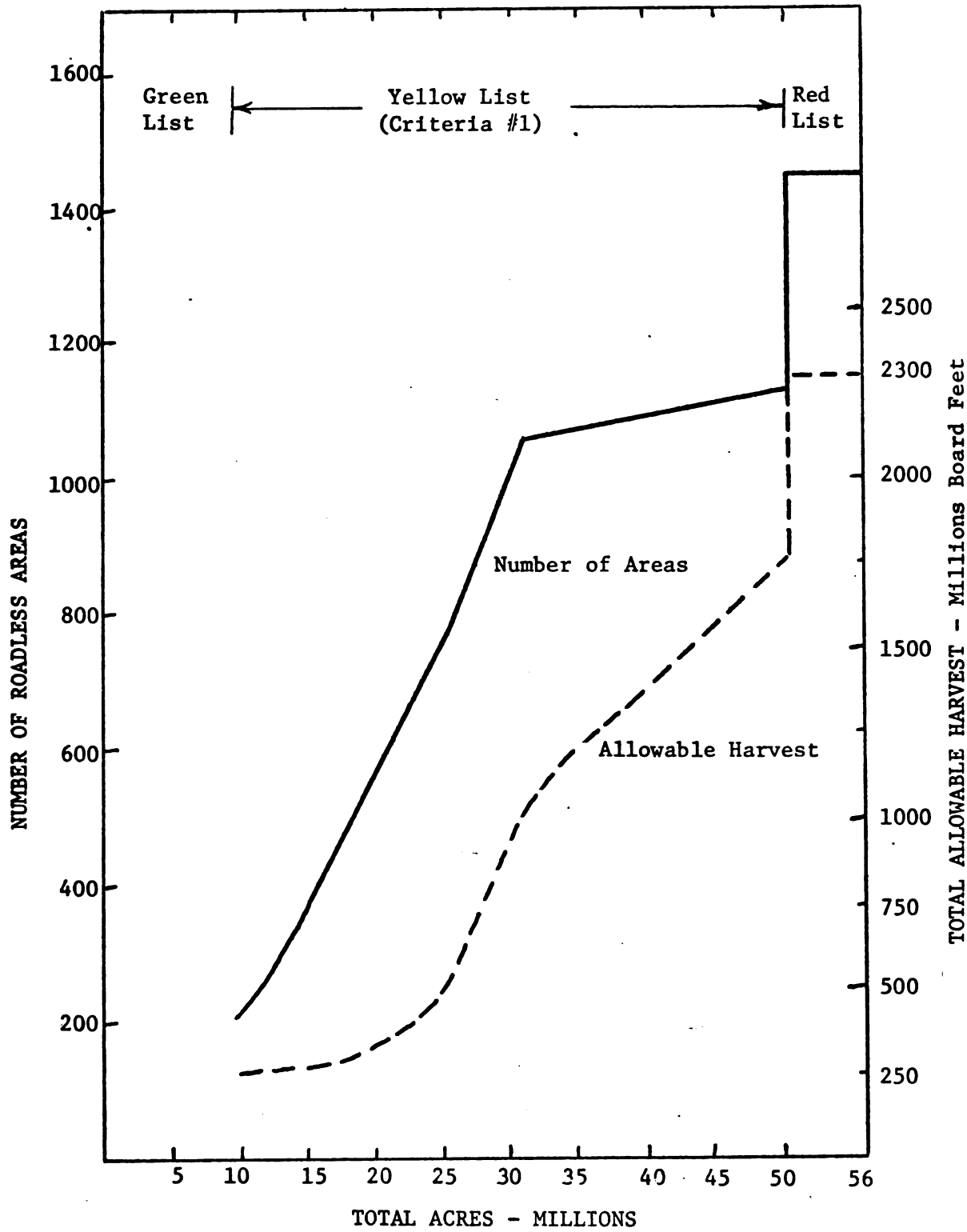


Figure 13.--Number of areas and allowable timber harvest related to size--alternative criterion #1--effectiveness/cost.

Cumulative Effects Under Criterion #2

Since only 25 areas containing less than a half million acres were added to the green list, the cumulative effects were essentially the same as the green list. The alternatives-of-size were so severely constrained that there was no issue of total size when this criterion was used.

Cumulative Effects Under Criterion #3

Since only one area is changed in the effectiveness/cost ranking to represent the larch ecosystem, this alternative has the same pattern of cumulative effects as criterion 1, effectiveness/cost (Figures 12 and 13).

Cumulative Effects Under Criterion #4

The pattern of cumulative effects changes significantly under the fourth alternative criterion, effectiveness/allowable timber harvest. As intended by the criterion, the timber impacts increase insignificantly up to 25 million acres, but beyond that point the impacts increase sharply (Figure 14).

In contrast, in the 10 to 15-million acre range the opportunity costs (Figure 15) increase more rapidly than they did with the first criterion, effectiveness/cost. The effectiveness pattern (Figure 15) is almost identical to that in criterion #1.

Cumulative Effects Under Criterion #5

The cumulative effects under criterion 5 (effectiveness x population/cost) are very similar to the effects for criterion 1 (effectiveness/cost) except the cost curve has a steeper incline in the 10 to 25-million acre range (Figure 16).

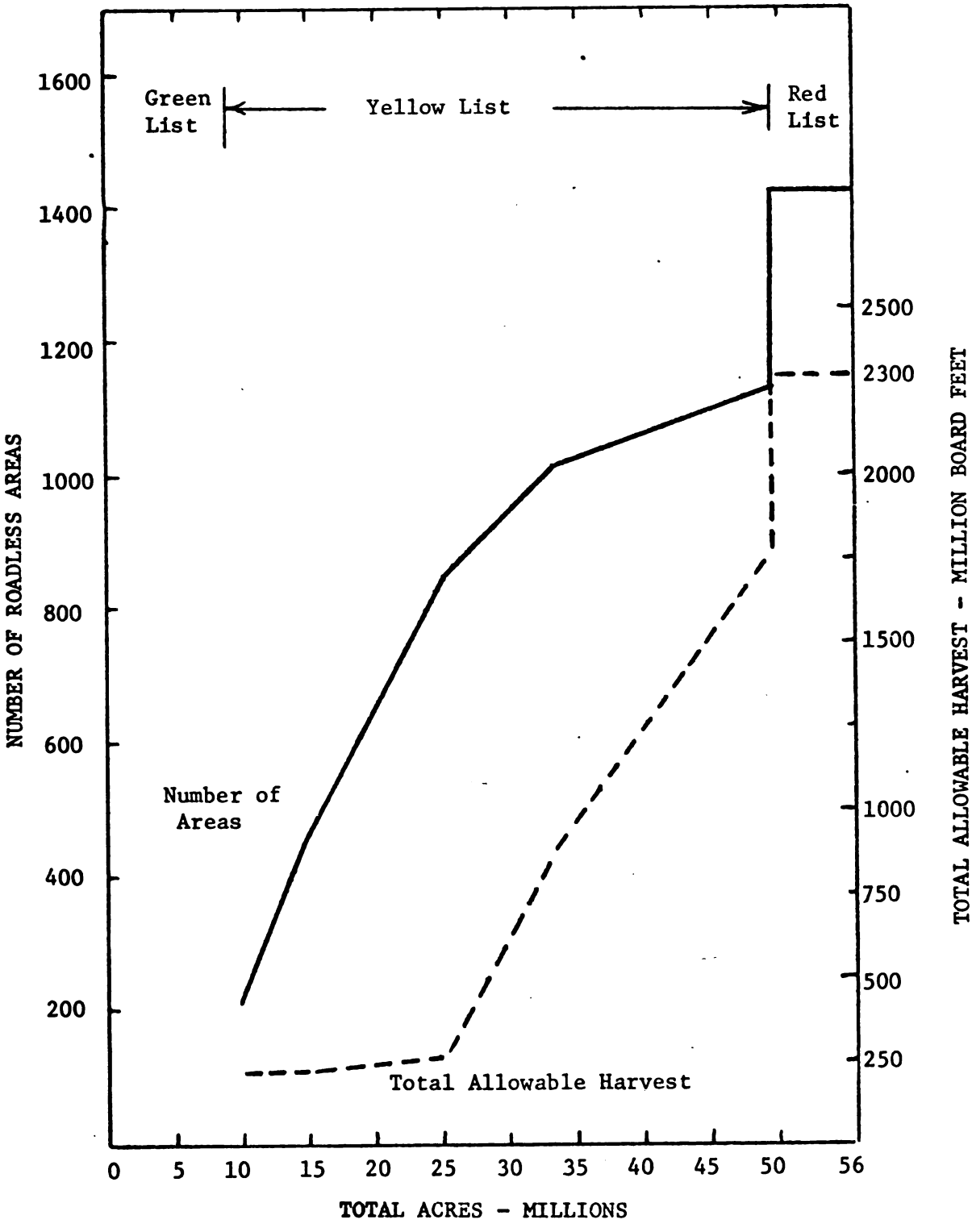


Figure 14.--Number of areas and allowable harvest related to size--alternative criterion #4--effectiveness/ allowable harvest.

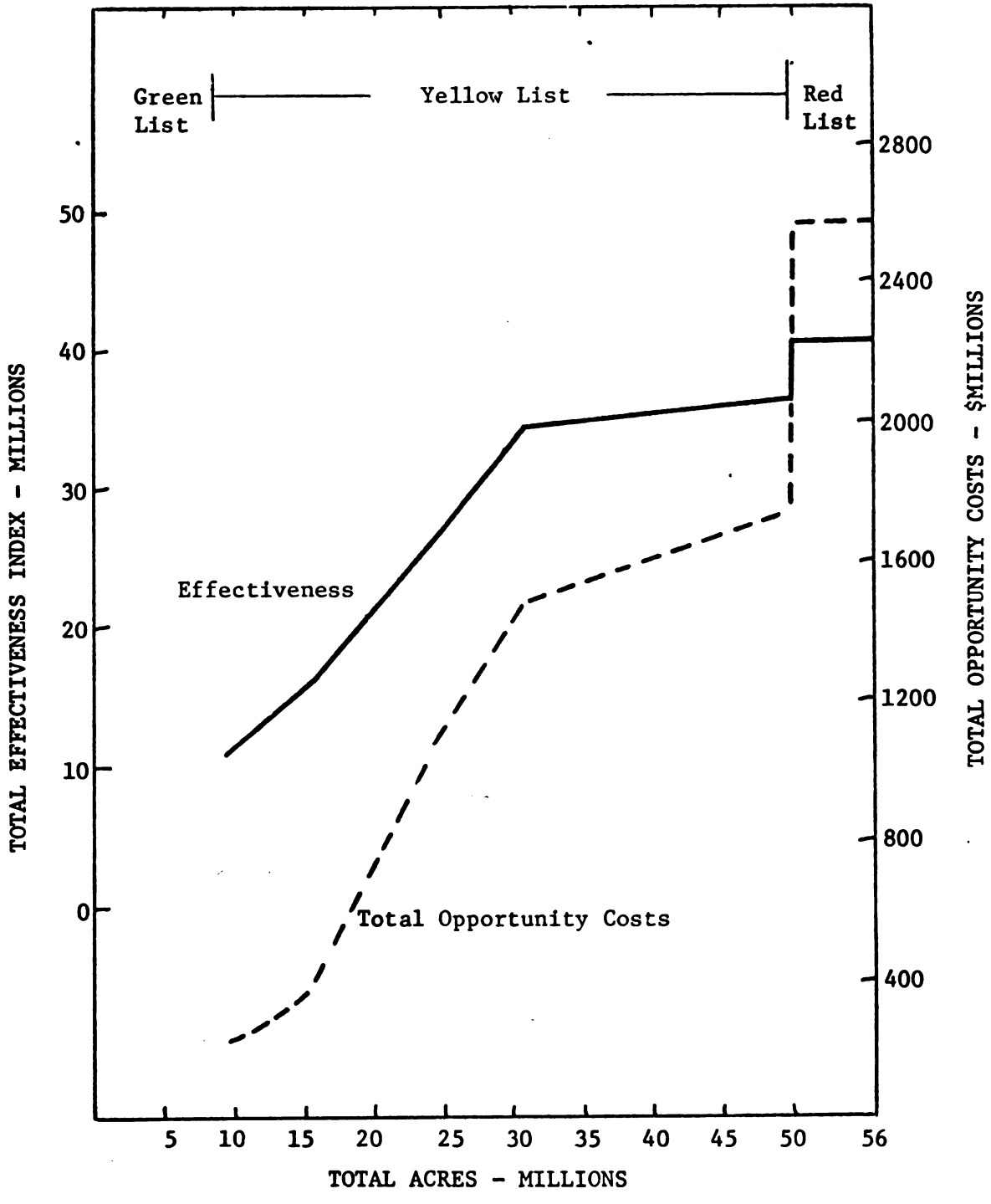


Figure 15.--Cumulative effectiveness and opportunity cost related to size--alternative criterion #4--effectiveness/allowable harvest.

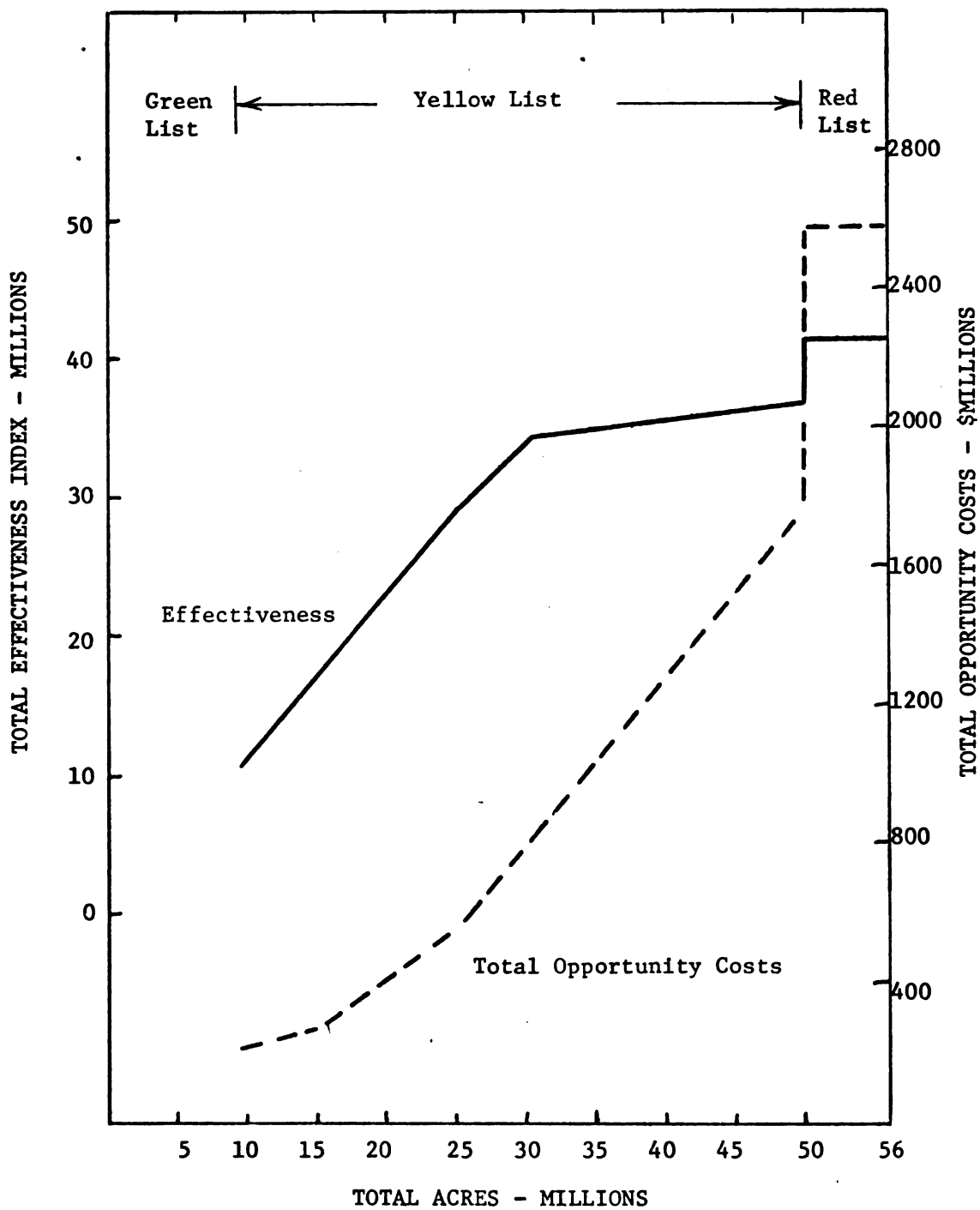


Figure 16.--Cumulative effectiveness and opportunity cost related to size--alternative criterion #5--effectiveness x population/cost.

Cumulative Effect With No Red or Green Screen

What would the cumulative effects look like if all 1,448 areas were ranked without using any red or green list criteria? The following graph shows the pattern of effectiveness, cost, and timber harvest when all 1,448 areas are ranked by criterion 1, effectiveness/cost (Figure 17).

If the green list criteria were not used, it would be possible to identify a more cost-effective mix of areas. If 200 areas, equivalent in number to the green list, were selected strictly on the basis of effectiveness/cost, the effectiveness would be about 10 million and the cost would be about $60 million. The effectiveness would be about the same or perhaps slightly less than the green list (10.7), but the opportunity cost would be less than a third of the green list ($223 million). Thus, a "pure" effectiveness cost criterion would provide about the same level of effectiveness for a given total number of areas, but the total opportunity costs would be much less than under the three-stage screening and ranking process used in RARE.

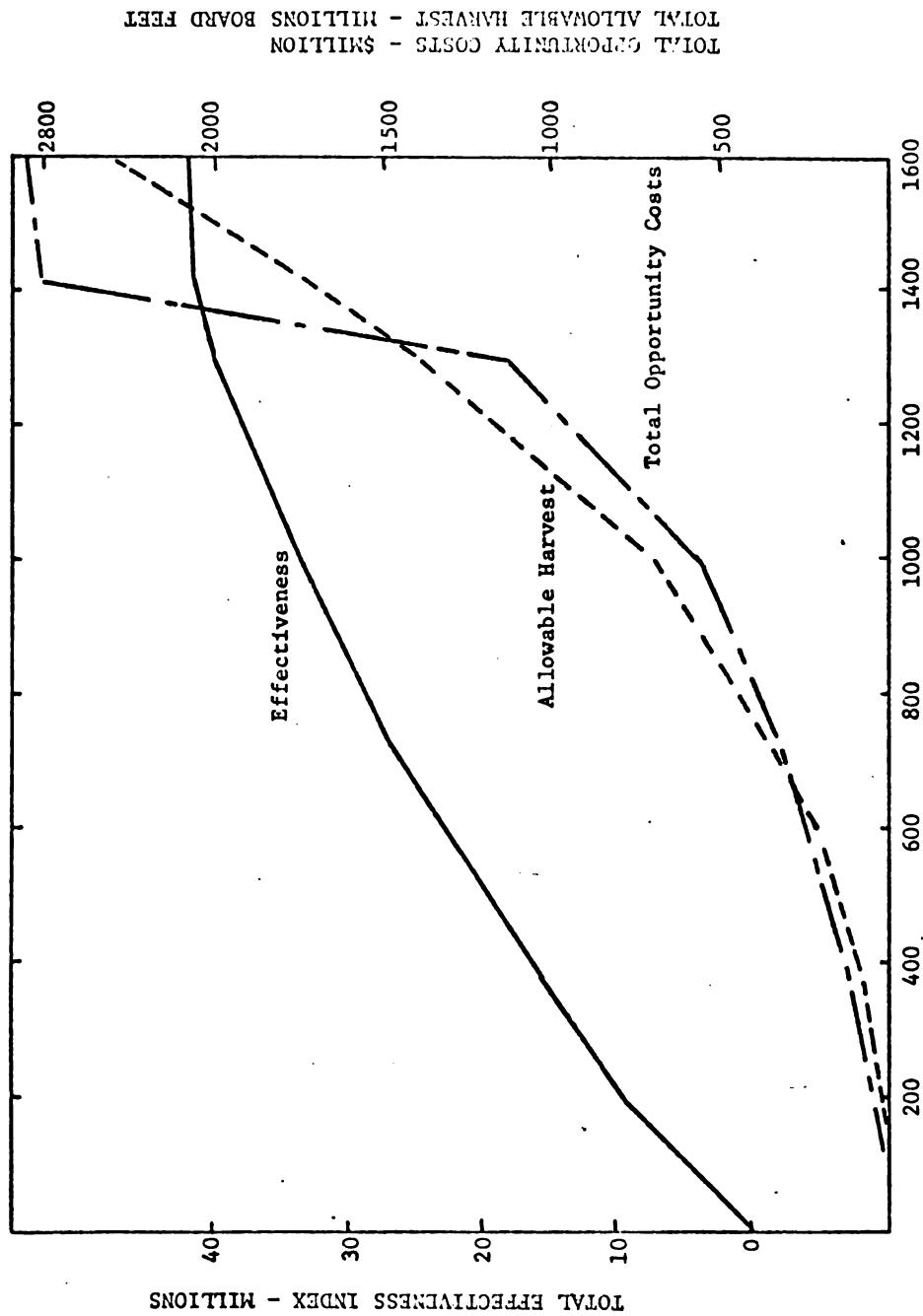


Figure 17.--Effectiveness/cost ranking all roadless areas.

VI. USE OF THE ANALYSIS IN DECISIONMAKING

In this chapter I describe how the RARE analysis was used by the Forest Service decisionmakers, and I give my own interpretations of the actions to the extent they may be of help in future analytical efforts. An ex post facto comparison of the actual decision with the analytical criteria is presented to provide some insight about the program objectives implied by the decision. Finally, a few conclusions are drawn about the usefulness of this type of program evaluation in Forest Service decisionmaking.

The results of the analysis, along with a proposed draft environmental statement and other pertinent material, were assembled into a loose-leaf "briefing" book for top managers of the Forest Service. The briefing book was used throughout the decisionmaking process on the tentative list of new study areas. In addition, the computerized data bank provided the capability to rapidly reanalyze the data in response to questions from decisionmakers.

The RARE data bank also found considerable use in responding to inquiries. During the course of the review a lawsuit was brought contending the Forest Service had not complied with the National Environmental Protection Act.[1] Data were assembled for the court as it requested, and this capability proved to be a valuable benefit of the data processing system.

The court case was dismissed after the Forest Service issued a directive that an environmental statement would be filed before any

---

[1]Sierra Club, et. al., v. Butz, et. al. (Civil No. 72-1455 SC, U.S.D.C., ND Calif.).

development action was taken on any inventoried roadless area.[1] This court action did not change the roadless area review process, but the environmental statement directive did cloud the distinction between new study areas and other roadless areas. All areas would be studied. New study areas would be studied with the expectation that significant additions to the wilderness system would result. Other areas would be studied as other types of program planning progressed. In either case the alternative of wilderness management would be analyzed before any irreversible developments were approved.

Once the briefing book was available, meetings were held to develop staff recommendations to the Chief. The regional foresters' recommendations, previously described, were supplemented by recommendations from the RARE task force and from the national forest system deputy chief and his functional division directors. These sessions were also used to test and critique the briefing techniques, agenda, and proposed decisionmaking procedure that would be used by top management.

Task Force Recommendations

The task force recommendations were developed in two steps. First, the work party made a recommendation to the steering committee. The steering committee then reviewed the analysis and the work party recommendations and decided on a task force recommendation.

---

[1]Memorandum from Edward Schultz, deputy chief to regional foresters concerning the roadless area review, November 28, 1972 (file designation 2100 Multiple Use, 2320 Wildernesses and Primitive Areas).

The work party recommended that the new study area list contain 12 million acres or about 2 million acres in addition to the green list. The basis for this recommendation was subjective, but it appeared to the work party that the social benefits of potentially doubling the size of the wilderness system were worth the apparent opportunity costs. The work party recommended that the list include the five areas with special features discussed under the green list criteria. The work party recommended that the third alternative criteria, ecosystem representation, be used to add more areas to the list in order to bring the total acreage to 12 million acres. The basic reason for the recommendation was that the cost for achieving the ecosystem goal would be slight, and the best of the more cost-effective areas would be added to the green list.

The analysis was then presented to the steering committee in the manner proposed for top management. The presentations were critiqued and improved substantially. Visual aids were used extensively. The work party recommendations were presented separately from the presentation on the analysis.

The steering committee felt there was little reason to hold the list to 12 million acres when the extra cost of including 15 million acres was very slight (see Figure 12). An economist on the steering committee compared the marginal effectiveness and marginal costs, and this comparison dominated the discussion on how large the list should be.

The political strategy options were also discussed. In general, if a small list were proposed, pressure for enlargement could be expected during the public review period. If a very large list were proposed, pressure for reduction could be expected from the timber industry, recreationists, and other interest groups. The task force concluded that it

would be inappropriate to reflect a political strategy in their recommendations. They felt that they should recommend what they felt the final decision should be, and the political strategy should be left to the chief.

The steering committee spent less time debating the criteria for selecting the mix of areas. In general, they concurred with the work party. The steering committee, with little discussion, strongly rejected the use of criterion #4, effectiveness/allowable harvest and criterion #5, effectiveness/population/cost. The task force recommendation to the chief was to include 15 million acres using criterion #3, ecosystem representation, to add areas to the green list. The steering committee did not discuss individual areas.

National Forest System Recommendations

After critiqueing and improving the briefing techniques, the analysis was next presented to the national forest system deputy chief, associate deputy chiefs, and directors of the following Washington office divisions:

Range management,
Wildlife management,
Watershed management,
Recreation management,
Timber management,
Land classification,
Engineering,
Lands, and
Fire control.

Deputy chief Edward Schultz was extremely pleased with the analysis. He felt it provided a very good basis for decisionmaking. However, several criticisms were raised. One argument, from the multiple-use planning section, was that selection of any new study area list was unwise, and that identification of such areas should be left to the normal multiple-use land planning processes. This was refuted by the deputy

chief as being politically and administratively impossible at that point in time. The omission of livestock opportunity costs drew an objection (from the division of range management) as did the omission of local employment and transportation system impacts (from the division of engineering). Opposition to including the five areas with special features was based on the premise that non-wilderness management was needed to properly manage the special features. A considerable amount of time was spent discussing this latter problem, although there was little disagreement that the five areas should not be included.

It was difficult to obtain a recommendation, but when time pressed at the end of the meeting, the recommendation to the chief was to limit the new study area list to the green list--10 million acres.

In my opinion, the national forest system presentation and discussion was relatively ineffective for the following reasons:

- the oral presentations were not designed for the specific audience,
- there was less confidence in the task force by those divisions not represented on the task force membership, and
- functionally oriented personnel appeared to view their role as advocates for particular clientele groups.

Line Officers Meet To Make Proposal

On December 12 and 13, 1972, the regional foresters met with the chief and his deputy chiefs in Washington, D.C., to decide upon a proposed list of new study areas. The briefing book had been available to the line officers for about one week.

The first day was devoted to presentations on the history of the roadless area review, summary of public involvement, the Sierra Club

-
-
-

lawsuit, the proposed draft environmental statement, and the RARE analysis. Visual aids, lighting, seating arrangements, and other details of the meeting received considerable attention. Viewgraphs and computer plotted map overlays were used to illustrate the screening results and compare the criteria alternatives. Separate presentations were made on the recommendations of the regional foresters, the task force, and the national forest system deputy chief.

The task force's suggested procedure was to then break into two evening sessions. One group headed by the chief would address the broad national question of how large the list of new study areas should be. The second group, headed by the associate chief, Rex Resler, would address the question of what criteria to use in deciding upon the distribution and mix of areas. Both groups would report back in the morning for the final states of the decisionmaking.

A planned dinner was held in a motel, and discussions were resumed immediately after the dinner. However, the group continued as one group throughout the evening. The discussion focused on the green list criteria, and numerous suggestions for modifying those criteria were explored. Most of the time was spent in clarifying the criteria and their implications; and, in my opinion, this discussion greatly increased the level of understanding of the analysis. No conclusions were reached, but the predominant questions seemed to be 1) what about those areas not recommended but with strong public support and 2) what about those areas with a high-quality index but not recommended by regional foresters.

At the end of the evening, the chief asked the work party to identify all yellow list areas which met the following green list criteria except for regional foresters' recommendations:

1. Areas with general public support for new study areas status (public involvement code 1), and
2. areas with a quality index greater than 155.

The first day's meeting adjourned and the work party queried the data bank using the GIM system. New printouts of areas meeting the new constraints were available at the beginning of the second day's meeting. This capability for rapid reanalysis of the data was an extremely important factor in the successful use of the analysis. Without this capability, the analysis might have collapsed at this point. However, decisionmakers found they had full control of the criteria. This created an atmosphere that they had to agree on criteria, and that the analysis could then be adapted to those decisions.

The second day began with a statement by deputy chief Deinema (in charge of administration) that he felt the green list criteria should not be changed. Rather, the group should add or delete areas based on whatever additional criteria might be appropriate. There seemed to be a concensus on this point.

The chief then suggested a series of specific review steps to go over each of the available lists. The chief made it very clear that he wanted a definite decision by the end of the day. The procedure was quickly agreed upon. The pace of the meeting accelerated, and each line officer participated fully and, in my opinion, enthusiastically. The work party was kept very busy recording decisions and reporting specific items of information as requested. At two or three points, associate

chief Resler called for a critique of the process and schedule, and minor adjustments were made. In my opinion, Messrs. McGuire and Resler did a superb job of managing the meeting and there was little deviation from the course agreed upon. By the afternoon of the second day, a proposed list of new study areas had been decided upon.

The final steps and criteria were described in the draft environmental statement (U.S. Forest Service, 1973) and are summarized here with minor supplementation based upon my own observations.

Selection Process

The following procedure was used in arriving at the proposed list of new study areas.

1. The green list was the starting point. The red list criteria were found acceptable and there was little or no discussion of the individual areas. Six areas on the green list representing uncommon ecosystems were evaluated individually and dropped from the list of new study areas. It was felt that the research natural areas system and other special programs, including those of other agencies, more adequately and more appropriately preserve such ecosystems for education and research purposes. None of the six areas had been recommended by regional foresters, and none of the regional foresters supported their inclusion.

In general, ranking of areas did not seem to appeal to the decision-makers. They felt uneasy about using ranking criteria because there was no objective basis for cutting off the list and deciding upon the total number of areas to include. The task force and national forest system recommendations for 15 and 10 million acres, respectively, probably had an implicit effect, but no explicit decision was recorded on the total number of acres that was desired.

In addition to the problem of deciding upon a cutoff point, the following observations also led to the conclusion that no single ranking criterion should be the sole basis for adding areas.

Criterion 1 - Effectiveness/Cost.--Of the five alternatives, this was considered the best for selecting areas, because it seemed most closely related to the general multiple-use concept of "highest and best use." However, it was decided that more weight should be given to public involvement, quality index, and to the remaining areas recommended by the regional foresters not included in the green list.

Criterion 2 - Geographic Dispersion.--Since this criterion identified only 25 areas, it was felt that the objective of dispersing wilderness areas over the western United States had been adequately met by the existing wilderness system. Little attention was given to this criterion.

Criterion 3 - Ecosystem Representation.--It was felt that the research natural area system adequately achieved the purpose of representing undisturbed ecosystems for scientific and education purposes.

Criterion 4 - Effectiveness/Allowable Harvest.--There was no support for this criterion. In fact, there was a conscious effort to avoid letting timber effects dominate the criteria. Since timber values were included in criterion 1, there was no felt need to further emphasize timber impacts.

Criterion 5 - Effectiveness x Population/Cost.--It was felt that this criterion overemphasized the recreation purposes of wilderness areas. One of the key problems was that areas ranking high according to this criterion also offered the best opportunities to meet intensively

developed recreation needs. Management and protection of wilderness areas near heavy population centers is much more difficult. The California regional forester, in particular, did not feel that public opinion in California was favorable for concentration of the wilderness system in that State. In my own opinion, this criterion should have carried considerably more weight; but it appears clear that allocation of land for wilderness toward more populated areas was not supported by the Forest Service.

While the ranking criteria were not used as intended by the task force, the effectiveness/cost criterion was utilized in the form of a constraint in the steps discussed below.

2. In the second step of the selection process, attention turned to the regional foresters' recommendations. There were 41 areas recommended by regional foresters which were not included in the green list. Each area was reviewed and discussed. The specific data inspected for each area were the quality index, the effectiveness/cost index, the public involvement code, and special factors orally presented by regional foresters. In general, an area was added to the new study area list if it had an effectiveness/cost index greater than 100. The 100 cutoff was selected as approximately representing the upper quartile of all effectiveness/cost ratios. Areas were also added if regional foresters felt strongly about their inclusion, and their quality indexes were reasonably high (no specific minimum was set). In several cases, regional foresters suggested that areas they originally had recommended not be included because of their low quality index or effectiveness/cost index. In a very few cases the chief overrode regional foresters' opinions and excluded areas with a very low quality index or effectiveness/cost index.

This second step resulted in 27 of the 41 areas being added to the proposed list of new study areas. Thus, about 90 percent of the regional foresters' recommendations were included in the proposed list of new study areas.

3. In the third step, the "new" printout of areas not recommended by regional foresters but with general public support in favor of new study areas (public involvement code 1) was reviewed. This list was quite long, and the chief suggested adding two additional constraints: (1) quality index greater than 155 and (2) an effectiveness/cost index greater than 100. The lists were manually adjusted by lining out areas which did not meet both constraints. There was only one roadless area that met all the constraints, and it was added to the proposed list of new study areas.

This was a time-consuming step. If an on-line type of computer terminal could have been used to instantaneously reanalyze the data, it would have greatly improved the process. Different modifications of these criteria could have been presented.

4. The final step in the selection process was to review the areas not recommended by regional foresters. High quality was defined as having a quality index greater than 155. Areas were rejected if they had public involvement code 2 (general opposition to new study area status) or if they had an effectiveness/cost index greater than 100.

This step identified 15 areas which were individually discussed. Eight of the areas were added to the proposed list of new study areas.

The following seven areas were not added to the proposed list of new study areas for the reasons cited:

Region	Name	Reason
Northern (1)	Meyer Mountain Pickard Pin	Small area only eight miles from a primitive area now under study.
Rocky Mountain (1)	Collegiate	Retain as backcountry; has heavy vehicle use now; 24 separate tracts of private lands included.
Rocky Mountain (2)	Electric Peak	Managed for backcountry recreation; has some primitive roads.
Intermountain (4)	South Horse Cr.	Is small area, near Bridger Wilderness.
Intermountain (4)	Cliff Creek	Contains primitive roads; has been partly logged; near Teton Wilderness.
Intermountain (4)	Rehabilitation	Contains some primitive roads; needs wildlife habitat improvement; near High Uinta study.
California (5)	Grouse Lakes	Complete management plan; other land use better.

The resulting proposed new study areas list contained 235 areas with 11 million areas (Table 10).

The areas were rather evenly distributed over the western United States (Figure 18).

The decisionmaking was concluded by a review of the proposed draft environmental statement and major points of disagreement were resolved. Plans for press releases were discussed.

TABLE 10.--Summary of new study areas by region

Decision Factor	Existing National Forest Wilderness System	NEW STUDY AREAS - REGION									Total
		1[a]	2[b]	3[c]	4[d]	5[e]	6[f]	8[g]	10[h]	ITF[i]	
Total effectiveness index (thousands)	24,840	2,163	2,842	972	3,566	1,098	1,451	40	264	10	12,406
Total opportunity costs ($millions)		38	33	26	40	41	72	1	21	<1	272
Total allowable timber harvest/year (million board feet)		55	38	44	17	51	85	0.4	11	0	301
Total acres (thousands)	14,687	1,704	2,009	747	2,197	682	980	37	2,567	8	10,931
Total number of areas	89	39	66	39	40	15	27	2	6	1	235

[a]Northern

[b]Rocky Mountain

[c]Southwestern

[d]Intermountain

[e]California

[f]Pacific Northwest

[g]Southern

[h]Alaska

[i]Institute of Tropical Forestry, Puerto Rico

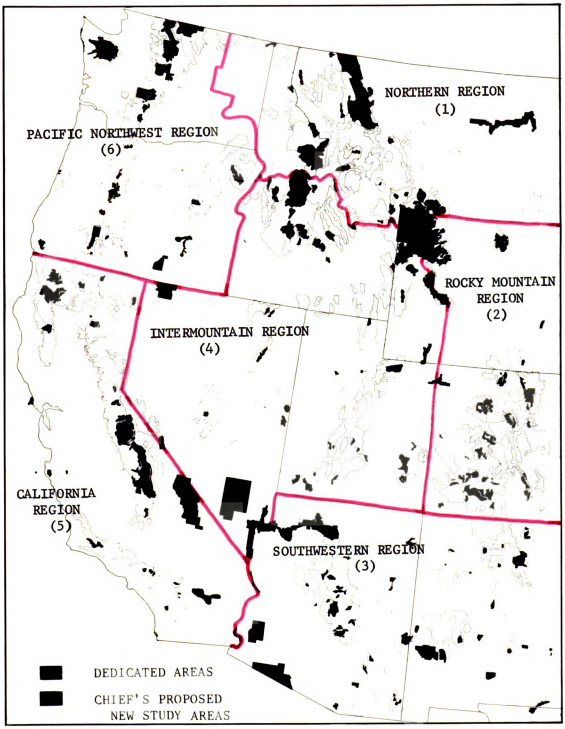


Figure 18.--Map of proposed new study areas.

In the days immediately following the meeting the draft environmental statement was reworked to reflect the decisions made. The most significant action was inclusion of a very explicit description of the decision process. Despite counsel that such a description need not be included, the chief insisted that the decision criteria be fully and completely discussed in the statement. This reflects an "openness" in decisionmaking seldom found in bureaucracies.

Implied Objectives

At first blush it would appear that the objectives had been obfuscated by the decision process, but a comparison of the resulting decisions with the explicit analytical criteria can shed light on the objectives implied by the decisions. Such implications may have a strong influence on both analysts and decisionmakers as the Forest Service moves forward in developing improved decisionmaking processes.

I compared the new study areas which were actually selected with those that would have been selected according to the analytical models, if the list had been limited to 235 areas (Table 11).

TABLE 11.--Comparison of actual proposed new study areas with the ranking criteria

Criterion	Percent of first 235 areas in the ranking that were new study areas
1 Effectiveness/cost	45
4 Effectiveness/allowable harvest	25
5 Effectiveness x population/cost	37
Expected frequency if no correlation	16

If all 1,448 roadless areas are ranked by effectiveness/cost without regard to the green or red lists, I found that 106 of the first 235 (45 percent) were proposed new study areas. If new study areas were randomly distributed through the ranking, only 16.2 percent would be expected to show up in the first 235 areas. The actual 45 percent indicates a strong correlation with a pure effectiveness/cost ranking. This suggests that maximization of net values is a strong goal of Forest Service line officers, but it is obviously not the only goal.

Criterion #4, effectiveness/allowable harvest, shows the poorest correlation with the tentative decisions. Only 60 of the first 235 areas were new study areas. This 25 percent occurrence is higher than the 16.2 percent expectation, because there is significant correlation between the effectiveness/allowable harvest and the effectiveness/cost criteria. Timber values are an important part of opportunity costs.

The coincidence of new study areas with the first 235 areas ranked by effectiveness x population/cost (criterion #5) was 37 percent which indicates this objective may play some role. However, the real reason may be the influence of public opinion. It seems reasonable to assume that new study areas are favored by people living in the more urbanized and heavily populated areas rather than in the rural communities dominated by extractive natural resource industries.[1]

---

[1]The average population index of all areas was 28,917. For those with general support for study (public involvement code 1), the average was 39,019. For those with general opposition (public involvement code 2), the average population index was 22,387.

Discussion and Conclusions

The RARE study experience indicates that systematic program analyses are helpful to line officers if the analyses are objective, timely, and provide a means for comparing the relevant alternatives. The era of staff analyses which present only one alternative is fading. Modern quantitative analyses techniques, planned by interdisciplinary teams, will undoubtedly be a major part of the managerial style of the Forest Service in the next decade. In my opinion, the RARE experience has greatly increased Forest Service line officers' confidence in the use of systematic program analyses.

It was quite evident throughout the two-day meeting that line officers, especially the regional foresters, felt the analysis and data bank were helpful to them. In fact, at the conclusion of the meetings Mr. Hurst, southwest regional forester, read a statement to the chief expressing the regional foresters' commendations on the decision process and analysis. Line officers did not appear threatened by the analysis, perhaps because their own views had been made an integral part of the analysis, and the final criteria were of their own choice. They were in command of the decision process.

However, the analysis did have a strong impact on the decisions. Ten percent of the areas recommended by regional foresters had been omitted because they did not appear as desirable when viewed in a national analytical context. The analysis highlighted some areas that had not been recommended by field units, but when viewed in a national context, they appeared much more desirable. Some were added. Without the analysis, the chief could have done little more than rubber stamp

the regional foresters' first recommendations. In addition, the analysis achieved the goal of making the cumulative national and regional effects visible at the time of decision.

The quality index, effectiveness, and public involvement factors in this case appeared to be more important in the minds of policymakers than opportunity costs, especially timber harvest. This is contrary to the common preservationist group image that the Forest Service is unduly influenced by the timber industry. Observations of the actual decision process in the roadless area review indicate that the decisionmakers strived for a reasonable balance.

The use of the GIM and GELO computer systems in the RARE analysis supports the conclusion that a generalized information management system is an effective tool for executing a program analysis. However, the analysis must be designed prior to data collection so that the right data are gathered, and unnecessary data collection is avoided. The volume of data can easily become overwhelming, for both men and machines, particularly under tight time constraints.

It was apparent that rapid and flexible data retrieval is very useful during the short time periods of critical decisionmaking sessions. In the future, we can expect to see the Forest Service move toward greater use of "man/machine" interfaces where both analysts and decisionmakers can experiment with criteria and query data banks. Simulation models may well provide the capability for decisionmakers to ask many "what if" questions before making actual resource allocation decisions.

However, the RARE experience also reaffirms that the Forest Service has been and continues to be one of the most decentralized agencies in the federal government. It was apparent that there is a strong reliance

on field officers' judgments and recommendations. As discussed in chapter IV, any given quantitative analysis is partial, and those most familiar with local and regional situations are depended upon to intuitively synthesize some of the complexities which cannot be covered in the analysis.

The program analyst's job would be greatly simplified if objectives and criteria could be explicitly decided upon when studies are begun. However, it seems unrealistic to expect that top management people always will be able to pre-identify the most helpful criteria for comparing alternatives. The true objectives tend to be identified as a product of the analysis.

While delineation of appropriate objectives and explicit criteria is the most difficult part of program analysis, ex post-facto evaluations of decisions can provide valuable insights on objectives to guide future analyses. The evaluation of actual decision behavior is a valuable supplement to the formally stated agency goals and authorizing legislation. The tentative decision on new study areas implies that a general national efficiency objective (maximize benefits minus costs) is an important objective, but not the only objective. Many objectives are left obscure.

Probably the most important contribution of the RARE study was that it provided a systematic way of thinking about and communicating about the allocation problem. The experience confirmed the contention that there is a place for economic theory in providing a way of thinking about such a "noneconomic" problem as wilderness. Some of the factors, such as the quality index, were rather crude and will be criticized, but a means for systematically considering these factors in decisionmaking was demonstrated. Even those most lividly opposed to the decisions have

a means for challenging specific factors or criteria, and alternatives can be proposed in a more rational framework.

Further research is desirable on how to better measure the effectiveness of wilderness, and perhaps the RARE study will stimulate more research efforts. The wilderness allocation question is not closed; it has just been opened. The list of new study areas is important, but it is just an interim planning step in the allocation of unroaded national forest lands among various possible uses. The challenge is great for improving program analysis techniques to help resource managers and legislators make the difficult decisions yet to be faced in the coming decades.

LIST OF REFERENCES

LIST OF REFERENCES

Catton, William R., Jr.
1969. Motivations of wilderness users. Pulp and Paper Magazine of Canada, Woodlands Section, December, pp. 121-126.

Fisher, Anthony and Krutilla, John.
1972. Determination of optimal capacity of resource-based recreation facilities. Natural Environments, ed. by John Krutilla, Johns Hopkins University Press, Baltimore, London.

Fisher, Anthony C., Krutilla, John V., and Cicchetti, Charles J.
1972. Alternative uses of natural environments: the economics of environmental modification. Natural Environments, ed. by John Krutilla, Johns Hopkins University Press, Baltimore, London.

Forest Range Task Force.
1972. The nation's range resources -- a forest range environmental study. Forest Resources Report No. 19, U.S. Department of Agriculture, Forest Service, Washington, D.C., 147 pages, illus.

Gilligan, James P.
1953. The development of policy and administration of Forest Service primitive and wilderness areas in the western United States. Ph.D. thesis, University of Michigan, Ann Arbor.

Haveman, Robert H.
1971. The economic performance of public investments: an ex post evaluation of water resource investments. Resources for the Future, Inc., Johns Hopkins University Press, Baltimore.

Hendee, John C., Catton, William R., Jr., Marlow, Larry D., and Brockman, C. Frank.
1968. Wilderness users in the Pacific Northwest -- their characteristics, values, and management preferences. U.S.D.A. Forest Service Res. Pap. PNW-61, Pacific Northwest Forest & Range Exp. Sta., Portland, Oregon, 92 pp., illus.

Hughes, Jay M.
1964. Wilderness land allocation in a multiple-use forest management framework in the Pacific Northwest. Unpublished Ph.D. thesis, Michigan State University, East Lansing.

Leopold, Aldo.
1921. The wilderness and its place in forest recreational policy. Journal of Forestry 19: 718-721.

McClosky, Michael.
1966. The wilderness act of 1964: its background and meaning. Oreg. Law Rev. 45(4):288-321.

McKean, Roland N.
1967. Efficiency in government through systems analysis. John Wiley & Sons, New York, 336 pp.

1968. Public spending. McGraw Hill, New York, St. Louis [etc.]

McKinley, Donald.
1963. Why wilderness? Forest Ind. 90(2):38-39.

Merriam, L. C., Jr., and Ammons, R. B.
1967. The wilderness user in three Montana areas. School of Forestry, University of Minnesota, 54 pp., illus.

Nash, Roderick.
1967. Wilderness and the American mind. Yale University Press, New Haven, 256 pp.

Outdoor Recreation Resources Review Commission.
1962. Wilderness and recreation -- a report on resources, values, and problems. ORRRC Study Report No. 3, University of California Wildland Research Center, 352 pp., illus.

Schubert, Glendon.
1960. The public interest, a critique of the theory of a political concept. The Free Press of Glencoe, Illinois, 244 pp.

Stankey, George H.
1971. Wilderness: carrying capacity and quality. Naturalist, Vol. 22, Special Issue #3, pp. 7-13.

The North Cascades Study Team.
1965. The North Cascades study report: a report to the Secretary of Interior and the Secretary of Agriculture, 189 pp., illus.

Tombaugh, Larry.
1970. Option and existence values of outstanding natural environments. Paper presented at 1970 annual meeting of the Southern Economic Association.

U.S. Congress.
1964. The wilderness act. Public Law 88-577, 88th Congress.

U.S. Congress.
1960. Multiple-use sustained-yield act. Public Law 86-517, 86th Congress.

U.S. Forest Service.
1970. Framework for the future, Forest Service objectives and policy guides. U.S. Department of Agriculture, rev. Feb., 1970.

U.S. Forest Service.
1973. Roadless and undeveloped areas, selection of proposed new study areas from roadless and undeveloped areas within the national forests. A draft environmental statement filed with Council on Environmental Quality, January 18, 1973, U.S. Department of Agriculture, Washington, D.C.

U.S. Water Resources Council.
1971. Proposed principles and standards for planning water and related land resources. Federal Register, Vol. 36, No. 245, pp. 24144-24194.