FOREST SERVICE WILDERNESS RESEARCH--THE PROBLEM, RESEARCH TO DATE, AND NEEDED RESEARCH

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Wilderness research is discussed under three headings in this paper. First, the need that justifies wilderness research is described. Then, research to date is briefly reviewed. The emphasis in this section is on research directly related to wilderness management, while recognizing that much research, particularly of a basic biological nature contributes to understanding wilderness. Finally, the third section presents one view of what the Forest Service should try to do in wilderness research. This organization means most of the same topics appear two or three times in different perspectives each time. The last section argues for a strong, Forest Service leadership role in wilderness research, based on an enlarged and more integrated program.

I. The Research Need--What's the Problem?

Land managers charged with the responsibility for wilderness do not have the knowledge base needed for informed management decisions. This practical need is the focus of all Forest Service wilderness research. Wilderness presents many intriguing research possibilities for a wide variety of scientific disciplines, but Forest Service research is and must be problem-oriented.

Wilderness is only a small part of the outdoor recreation picture, but it is essential to fill out one end of a broad spectrum of diverse

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opportunities. The National Forests play the pre-eminent role in providing the benefits of wilderness for the American public. Almost all officially designated Wilderness is on the National Forests now, and the greatest part of any future Wilderness system will almost surely be provided on lands now administered by the Forest Service. The National Park Service also has substantial wilderness resources, followed by the Bureau of Sport Fisheries and Wildlife.

The management problems that wilderness presents are severe today and becoming more difficult rapidly. Use pressures are growing rapidly on a shrinking resource base which has severe constraints on its capacity to accommodate use, and management techniques are poorly developed.

Wilderness Use

Recreational use is the major use of wilderness and presents the major impetus to the intensification of management problems. Use is heavy now in some Wildernesses, especially in California and Minnesota, and many if not most wildernesses have popular places that most observers would agree are used beyond their capacity. Overuse is causing resource damage and degrading the quality of the visitor's experience. This deterioration appears incompatible with the concept of wilderness and if not corrected, seems to be in violation of the Wilderness Act.

Furthermore, wilderness use has been increasing rapidly and seems likely to continue to climb steeply. Use of National Forest Wilderness grew from 400,000 man-days in 1946 to 2,900,000 man-days in 1964--over a 7-fold increase in 18 years. Visitor-days replaced man-days as the

recreational units of measure in 1965, and because of differences in definitions conversion of use estimates to one common measure is not possible. Thus there is a break in the record, but the trend since 1965 continues up. National Forest Wilderness use has grown at a higher rate than campground use since 1945, despite the car camping boom during this period. In 1946, Wilderness use was 5 percent of National Forest campground use. By 1970, it was 17 percent. Estimates for use of National Park de facto wilderness are not available, but Park Service officials describe similar trends.

Two projections (ORRRC Report 3 in 1962 and the Forest Service in 1959) show expected 8- to 10-fold increases in Wilderness use from 1959 to 2000. There are good reasons for this large projected increase, which exceeds the growth projected for other types of outdoor recreation. The social makeup of the U.S. is shifting and the kinds of people who use wilderness--well-educated, urban, professional-technical people, with at least moderate incomes--are a rapidly expanding segment. Growing public concern for environmental quality and interest in ecology also could contribute to more use of Wilderness, as well as more intense and costly controversy over wilderness policy.

Wilderness Capacity

Meanwhile, the total wilderness resource is shrinking. Part of this resource is officially designated as Wilderness and Primitive Areas. This totals almost 15 million acres, (0.6 percent of the U.S. excluding Alaska and Hawaii) and has grown only 3 percent in 25 years. Undeveloped,

"de facto" wilderness is only now being inventoried the first time; thus there is no data on trends in area, but it clearly is shrinking as roads replace trails. Since 1945, the road mileage on National Forests has doubled, while trail mileage has dropped one-third (according to the Chief's Annual Reports). The decrease in "de facto" wilderness more than offsets the small growth of official wilderness.

Both law and public opinion indicate that Wilderness is supposed to be relatively uncrowded and substantially unmodified by visitors. The Wilderness Act states that Wilderness must "provide outstanding opportunities for solitude." Conflict between this objective and growing use appears certain. The legal restrictions on structures, improvements, and the use of mechanized equipment greatly restrict the role of "engineering solutions" in coping with use pressures.

Wilderness Management

Wilderness management is intrinsically difficult, and unique to a considerable extent. Subjective, poorly understood elements are critical. Management must be skillful, subtle, and as inconspicuous as possible. There is little to draw upon from past management experience. With a few exceptions, at least until very recently, management has been limited and essentially custodial, largely incidental to fire control. The management challenge is just coming to be recognized by professional land managers, and its full dimensions are not yet entirely clear.

Two sorts of general problems stand out:

1. Absence of both criteria and data to help guide decisions in the allocation of land to Wilderness or to other, alternative uses.

2. Absence of knowledge for planning the management of existing Wilderness (and closely related, dispersed recreation areas) in two major ways:

a. Maintaining the wilderness ecosystem in as nearly a natural, unmodified condition* as possible,

b. Managing use to maximize the quality of the visitor's experience for an optimum level of use.

II. Current and Past Wilderness Research

Almost all substantive wilderness management research has been done within the last decade. The Forest Service's contribution has been modest, but it still constitutes the bulk of what has been done.

The main other wilderness research was ORRRC Report 3, Wilderness and Recreation--A Report on Resources, Values, and Problems. For a first effort, prepared under extreme time pressure, it provided a good deal of useful information and identified some problems and research needs more clearly. However, its data are over 10 years old now, and shortcomings in some of the data collection methods are now more evident than before. Thus, it has little direct usefulness to land managers in the 1970's.

There have been only a few other small, scattered studies by scientists in universities and some other government agencies, including some in Canada. The U.S. National Park Service has done some ecological research.

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* Both law and policy establish natural conditions as the management objective, rather than attractive conditions or recreational assets.

Visitor Studies

The emphasis in research directly related to wilderness has been on understanding visitors in relation to management of existing wilderness. This emphasis seems appropriate, and it agrees with the emphasis for outdoor recreation research in general recommended in the recent National Academy of Sciences report on A Program for Outdoor Recreation Research. Visitor management is a pressing problem right now, and the rate of change in use and the problems it causes is probably faster than broad ecological change affecting whole wildernesses. Little is known about wilderness visitors, research on users is in its infancy, and transferring knowledge from studies elsewhere is harder than for biological topics. Furthermore, wilderness management consists mainly of managing use rather than the physical resource, in the opinion of many National Forest officers. This is dictated by the Wilderness Act's insistence on an unmodified environment and absence of structures and improvements. "Hardening" sites, sewage systems, horse control structures, etc., these officials feel, are not appropriate actions.

Four Forest Service Experiment Stations have been substantially involved in wilderness user research. At the North Central Station, Dr. Robert Lucas studied the use of the Boundary Waters Canoe Area in the early 1960's, analyzing the amount, type, and distribution of use, factors related to visitors' locational decisions, capacity and use conflicts, and attitudes towards management alternatives. After a lapse in BWCA visitor studies, Dr. David Lime of the North Central Station is now

beginning research on the relationships between levels of use, frequency of encounters between visitors, and visitor satisfaction. The unique character of the BWCA limits the transfer of knowledge from there to most other Wildernesses, however.

The measurement of Wilderness use was studied by Wiley Wenger of the Pacific Northwest Station in the early 1960's. George James and Dr. Hans Schreuder of the Southeastern Station, together with Lucas of the Intermountain Station, have picked up where Wenger stopped. There is not yet a satisfactory, standard use measurement system to recommend, however, due to the difficulty of the problem. Work by the Southeastern Station is continuing, and the Missoula Equipment Development Center is participating in the search for automatic counting devices. If visitors were required to register and complied reasonably well, use measurement would cease to be a research problem.

PNW Station scientists Dr. William Burch and Wenger also studied Wilderness visitors in comparison to car campers. They found indications of a learning process whereby some children introduced to the outdoors through car camping with parents developed the interests and skills to "graduate" to the Wilderness--which suggests the camping boom may produce Wilderness "fallout" later. More recently, Dr. John Hendee and University of Washington collaborators studied the social characteristics and management preferences of Wilderness visitors, and developed an attitude scale for measuring the visitor's degree of wilderness purism. The focus of the PNW recreation research is on sociological research in general, rather than Wilderness, however, and the current studies are outside Wilderness.

The Intermountain Station launched a new wilderness management research work unit in 1967, located in Missoula, Montana, a strategic central location for over half the U.S. Wilderness (outside Alaska--where there is no official Wilderness). The broad, multifunctional program outlined in a statement presented to the Senate Committee on Appropriations in 1966 called for $300,000. Only $75,000 was appropriated, so only a part of the total program could be developed. This program in Missoula led by Dr. Lucas is concentrating on visitor studies, use patterns, visitor characteristics, attitudes concerning wilderness, its use and management, and, particularly on the esthetic or social carrying capacity of wilderness and on management to match use to capacity. There has also been research on improving research methods.

In general, Forest Service Wilderness visitor research has only involved two to three scientists at any one time over the past 10 years, and has been necessarily rather exploratory, and descriptive. Studies have been observational rather than experimental. Almost all past visitor studies have focused on summer visitors, despite the fact that some western Wildernesses may be used more in the fall than in the summer.

Resource Allocation

Research aimed directly at aiding in land classification decisions has been almost non-existent. ORRRC Report 3 touched on it, and Dr. Jay Hughes of the PNW Station did a conceptual review of the economics of wilderness land allocation. Very recently, Drs. Cicchetti, Fisher, and Krutilla of Resources for the Future have begun methodological investigations on

this topic. The main emphasis to date, however, has been on research related to management of the Wilderness already classified rather than on what land should be Wilderness. Some of the visitor descriptive studies have shed a little light on the allocation decisions, but it has been indirect and peripheral. For example, these studies have thrown doubt on a common stereotype of Wilderness visitors as a wealthy, leisured élite from the East, making long, expensive trips. The more accurate picture of visitors relates to the distribution of benefits and thus has implications for wilderness allocation. It represents only the first of several required stages in research before adequate, informed land allocation decisions can be made.

Wilderness Ecology

Research specifically on wilderness ecology has been limited. The main effort, started four years ago, has been by Drs. Heinselman, Ohmann, and Ream of the North Central Station, working in the BWCA. The historical ecology of the area, particularly the fire history, has been carefully pieced together, and much of the present vegetation has been described in detail. The animals of the BWCA, especially wolves, deer, and moose, have also been studied. Again, the BWCA's uniqueness makes this knowledge hard to transfer elsewhere; knowledge of BWCA ecology provides insights into the general processes of succession in natural plant communities, but translating this into a management plan for a specific Wilderness in the West will require research in other, more comparable areas.

A similar, but much more limited study of the natural ecosystem in part of the Bob Marshall Wilderness is being done by the Intermountain

Station cooperatively with the University of Montana. The focus is on the total ecosystem, although the large decline in the area's elk herd is of particular concern to some visitors and outfitters.

A joint study by scientists from the Northern Forest Fire Laboratory and National Forest system people is being conducted in the White Cap drainage of the Selway-Bitterroot Wilderness. The study is seeking the knowledge necessary to consider ways to allow fire to more nearly play its natural role.

The National Park Service has launched ecological research oriented at management, including studies in Sequoia-Kings Canyon, Yellowstone, and Isle Royale, again with a considerable emphasis on fire's ecological role.

Visitor impacts on wilderness soils and vegetation have been studied in alpine areas in several National Parks (particularly Rocky Mountain National Park by University scientists) and in the BWCA by University of Minnesota cooperators.

There has been, of course, a great deal of ecological and other biological research outside wilderness for many years. Research on succession following fire has been done, and much nonwilderness silvicultural and range research. Much of this research has concentrated on commercial species and environmental conditions that are not representative of the generally harsh, high elevation wildernesses. More is known about white pine, ponderosa pine, and larch than alpine and subalpine plant communities, although there are studies of high elevation vegetation. Work by Dr. Jerry Franklin, PNW, is a case in point. At least until recently, a large part of research in forestry had been oriented more

towards timber production than the ecology of the whole community, and much of it has related to management practices generally inappropriate to wilderness objectives, such as thinning, planting, fertilizing, and so on. Much of this general biological research has applicability to wilderness conditions, but knowledge of wilderness environmental conditions is limited, and it is hard with this present limited knowledge to assess the degree of similarity between the study areas and wildernesses. Wilderness could be classified by habitat types, but until this is done beyond the few areas mapped (particularly by Reed, Daubenmire, and Franklin) applying existing knowledge of each habitat type is difficult and any application to wilderness management is hampered.

Critical questions concerning wilderness wildlife and wildlife habitat are particularly hard to answer on the basis of the skimpy research done elsewhere. Most wilderness is in the northern Rockies, but wildlife habitat research here is very limited. Part of it, however, by Dr. Lyon of INT, deals with the effects of fire, and is potentially highly relevant. Several important wildlife species can be called "wilderness species"--mountain goats, wolverines, and grizzly bears in particular--and knowledge of their requirements is needed.

Research on the use and control of fire has general relevance to wilderness fire management, but any application to a particular Wilderness will require far more specific knowledge about individual Wildernesses and modified types of fire control.

III. What Is Needed:

Visitor Research

Ecological research is essential to all aspects of land management and should be accelerated. However, within the wilderness research program social research on wilderness visitors seems to deserve higher priority in the short run if the present limited budget continues. Reasons were mentioned before--severe management problems right now, rapid changes in use and intensification in resulting problems, more uncertainty about the desirability and feasibility of various management alternatives, and less relevant knowledge than for ecology. For much the same reasons, plus intense controversy, social and economic research on wilderness land allocation shares this top priority.

Upgrading wilderness management to a truly professional level will be impossible with the presently available knowledge of wilderness visitors. At least moderately accurate basic information on wilderness recreational use--amount, type, timing, and areal distribution--is a minimum need. Without this use data, wilderness managers are as hampered as range managers would be without data on grazing use or timber managers with nothing more than once-a-year guesses as to timber cut (and with the guesses only available for whole Ranger Districts rather than specific locations, and with almost no data on species cut). Experienced administrative officers working with the same Wilderness sometimes disagree as to whether the area's main use season is summer or fall, whether half or one-fifth of the visitors hike, how long they stay, where they go, and their estimates as to the level of use may vary by a hundred percent or

more. Research experience with administrative use estimates indicates serious inaccuracies.

Beyond basic resource use data, information on the visitors and their behavior, knowledge, and attitudes is essential for planning efforts to help visitors achieve their objectives within the framework of law and agency policy. Disagreements among wilderness managers as to what visitors are after, and how they might respond to management actions is just as common as for use estimates. Current visitors are not the whole problem; potential visitors and dissatisfied dropouts are both highly significant.

Probably the major question is how to define an optimum level and mix of use for each wilderness, and how to achieve it. Carrying capacity is a complex concept in wilderness. Environmental impacts and the quality of visitors' experiences are both crucial, but less is known about the experience dimension. Matching use to capacity will involve redistributing visitors, and any program to do this must be based on knowledge of visitor objectives, influences on visitors' locational choices, and the acceptability of alternative approaches to redistribution. Much can probably be accomplished through providing visitors with information about areas and opportunities, thus influencing their decisions indirectly, rather than by "playing policeman." But doing this effectively will require more knowledge of both wilderness resources and visitors' behavior than we presently have. Better data on the recreational attractions, potential campsites, and travel routes of individual Wildernesses will be needed to analyze use patterns and plan efforts to alter patterns. Putting any kind of a ceiling on use will need similar information even more.

Knowledge of people, their activities, and their ideas could help managers make decisions about managing visitors, but this does not mean that policy need be dictated by the attitudes or response of visitors. An opinion poll or a use survey is not a simple, direct prescription for management. Visitors' desires may be impossible to fulfill, shortsighted, selfish, or in conflict with others' ideas or with basic policies. Both attitudes and behavior of visitors may be based on misinformation, and may be changeable or capable of being changed. Even with the best survey techniques, what people say does not always indicate what they would actually do. Attitudes and perceptions need to be analyzed in depth, interpreted in a broader context, and related to ecological knowledge and wilderness objectives, but attitudes cannot be ignored.

At this stage, given the limited number of small-scale, widely scattered, noncomparable visitor surveys spread thinly over the past ten years, one major need is for an accurate, uniform, comprehensive survey of users in all wilderness. This would fulfill one important management need, and lay the essential foundation for more narrowly focused studies. This recommendation also parallels the National Academy of Science's suggestion for outdoor recreation research generally.

Visitor research also needs an intensive effort to develop and refine sampling techniques adaptable to wilderness conditions. Widely dispersed, highly mobile wilderness visitors, and great fluctuations in use at any point from day to day have reduced the effectiveness of standard survey techniques seriously. Most past samples have been small and expensive to obtain, and frequently biased and nonrepresentative.

Past wilderness research has lacked continuity over time. The isolated, one-shot studies, without followup investigations, must be replaced by longer term research to begin to pin down trends in all aspects of wilderness use and wilderness visitor characteristics--shifts in behavior, objectives, knowledge and attitudes as much or more than nose counting.

Observational, survey research is the essential first step, but the knowledge gained should be integrated into simulation models (computer-based models of particular areas) that can be used to test the likely effects of alternative management decisions on visitor numbers, use patterns, and visitor satisfaction.

The next step should be to field test, under controlled and monitored conditions, the more promising management steps.

The past neglect of fall visitors must be corrected. (The Missoula wilderness research unit is studying fall visitors now.)

The result of visitor studies would be more valuable to wilderness managers if the time lag from field work to reporting could be shortened, and this would be possible with better financed research.

Wilderness use also must be studied in relation to the larger, interdependent system of Wildernesses and related areas, rather than in isolation. What would the effect of a system of nonwilderness trail recreation areas be on the use of the Wilderness, for example? If Wilderness is to successfully fulfill its own specialized function, it cannot be forced to support other sorts of recreational demands that could better be accommodated on related, supplementary types of areas. Any

programs to limit use, or restrict certain types of use would be more fair, more acceptable to the public, and more likely to achieve objectives if adequate alternative areas are made available.

The development of a variety of management programs for recreational environments intermediate between Wilderness and intensive development has great potential, but an almost complete knowledge vacuum exists on the subject. What different kinds of areas are needed, in terms of size, characteristics, regulations, facilities, and location? How much more intensive could recreational use be in nonwilderness trail recreation areas than in Wilderness? How much more acceptable would other uses (logging, grazing, mining, water storage) be in intermediate areas, compared to Wilderness? What sorts of Wilderness use can be voluntarily shifted to other types of land? How much use can be shifted? Could intermediate areas backfire--creating interest and skills that might serve as stepping stones to increased wilderness use?

Wilderness Classification

This last question leads into research aimed squarely at the land allocation decisions involved in wilderness classification. This would involve developing and applying measures of national need for the alternative services available from still undeveloped wildlands in terms of benefits and opportunity costs of foregone uses. The recently developed concept of "option demand"--the value of holding on to the possible future chance of purchasing or experiencing something in the face of a decision with essentially irreversible consequences--seems particularly appropriate

for Wilderness, and needs to be investigated to make allocation decisions truly in the national interest. In addition, the current lack of knowledge of the local community impacts of Wilderness or other designations must be corrected if Wilderness classification decisions are to be improved. This would involve objectively assessing the total economic and social effect, as well as the possible indirect effect of natural amenities such as Wilderness on regional urban centers. This will be very demanding research, both in terms of scientific skill and objectivity. It will also require large amounts of data. Wilderness classification is a controversial subject, but this is exactly why research is needed--avoiding it because it is a "hot potato" seems like the opposite of what is needed.

Ecological Research

The needed ecological research includes basic inventories, first, just as recreational use needs a basic description as a starting point. Vegetation is probably the component of the natural environment most in need of being inventoried. Vegetation is fundamental to animals as their habitat, it can be altered greatly and quickly by man as land forms cannot be, and it is a major part of the scenery. Inventories are dependent upon some sort of ecological classification, existing, adapted, or new. But animals, soils, water, and other components also need to be inventoried. An inventory has value for many management purposes (protection, locating trails and campsites, interpretation, etc.). In fact, it serves as a base for judging any management action. It is also an essential base for many sorts of biological research. The inventorying should involve mapping.

At some point, inventorying becomes a management task, but research is needed to develop systems for doing the job.

Second, historical ecological research is needed to suggest what the typical natural conditions might be without technology's influence, rather than to describe plants and animals in detail for each specific site as they existed on some historic day (which may have been generations before civilization made any imprint on the area). In other words, how did conditions vary as nature's rolls of the dice came up one way or another before man's technology got in the game? Probably only a few sheltered spots are still entirely in the natural, unmodified state. This requires that earlier conditions be investigated by historical methods and by biological sleuthing from clues in long-lived trees, snags, fossils, evidence of plant succession, and so on.

Third, with this sort of information, it would be possible to compare the present wilderness with a reconstructed picture of its natural condition, both in terms of plant and animal communities and the forces that make up their environment. Furthermore, projections of future change under the continued status quo could be developed and compared to the natural situation. It could be determined if the wilderness was moving toward more typical natural conditions or farther away.

Finally, if these comparisons show that the goal of maintaining natural conditions is not going to be achieved under the present management, plans could be made to reintroduce missing or reduced influences, or to find substitutes for them, and to minimize or eliminate man's effects, or to take steps to counteract these effects.

Fire is probably the most altered influence. Insects, diseases, avalanches, and so on are also important factors, but modern man has changed these forces less than he has changed fire. (Man has introduced both insects and diseases, but some of the most serious--white pine blister rust, chestnut blight, Dutch elm disease, and larch casebearer, for example--affect species that are rare in wilderness. In any case, man's ability to undo the damage is much more limited than is the case for fire. For fire, there are management options and alternatives.) Fire was a major force in natural ecology, destroying and creating, and producing what the first explorers found in most places. Modern fire control is very effective, with radios, airplanes, parachutes, gasoline engine pumps, bulldozers, chemical retardants, infrared scanners, and so on as tools. As a result, fire has been greatly reduced as an ecological force for the last generation or so. This has been reflected through the encroachment of trees on meadows and brushfields, and it has had a magnified and obvious effect on elk and deer populations which have dropped in many wildernesses. Equally important effects on other, less conspicuous birds, small mammals, and other organisms seem likely, and need to be investigated.

Fire exclusion has had unnatural ecological effects, but a complete hands-off approach to fire control in wilderness is also out of the question. Danger to lives and to adjacent areas dictates some sort of control, and the wilderness areas are too small a remnant and too valuable for us to allow a very large part to burn at one time. Furthermore, where fire has been excluded for many decades, fuels may have built up conditions for an

unnaturally severe fire, particularly in some plant communities naturally subject to frequent light fires.

The challenge to research and management is to develop the ability to let fire approximate its natural role as closely as feasible. We need to learn to control the unwanted effects of fire while allowing it back in the ecosystem at least part way, recognizing the many real problems that make continued fire control necessary. This effort should involve fire research as well as ecological study. With better knowledge of wilderness fuels, fire danger rating, natural fire barriers, and new control methods, and with better weather forecasts, wilderness managers could consider letting at least some natural fires burn freely with much less risk than now. The limitations inherent in this approach might suggest evaluating prescribed fires as a supplement, or ways of producing similar effects somehow without fire.

Deliberate planning and action, such as in the example of fire, seem necessary to offset the unintentional or unavoidable effects of civilization. The alternative, often called "preservation," seems self-defeating. Since the "preservation" alternative usually excludes certain natural forces, especially fire, it produces not preservation, but sure, steady change to something unlike the original North American wilderness and unlike the environment specified in the Wilderness Act. The fact that the goal, like almost all goals is not 100 percent attainable is no reason for not trying; the impossibility of achieving perfect justice or health does not stop efforts to improve law or medicine.

The real choice seems to lie between unintended, accidental, inescapable man-caused change away from natural conditions on the one hand, and conscious planning to minimize and offset man's impact on the other. Total noninterference is simply not one of the choices, whether we like it or not, but corrective action must be taken carefully, with an information base that is lacking now except perhaps for the BWCA. We must be cautious but not overcautious; the Wilderness Act imposes a responsibility that calls for neither hasty action nor inaction.

In depth studies of the species of animals that depend largely on wilderness habitats are needed, especially studies of these animals' requirements for continued survival. Rare and endangered species, such as Montana westslope cutthroat trout and grizzly bear deserve special attention, as do several uncommon animals listed as "status undetermined" in the "Red Book"--wolverine, lynx, pine marten, and fisher.

The problem of offsetting man's direct impact, on campsites especially, also remains to be solved. Past research indicates that even light use produces large changes. Better ways of choosing more durable sites, of increasing site durability within the spirit of wilderness, of restoring deteriorated places, and of controlling visitor and horse use are needed.

General

In general, substantial advances in research related to wilderness management seem much more likely if the research effort can achieve a "critical mass." The problem is very large and diverse. A wide variety of interrelated questions call for a wide variety of skills and viewpoints--

ecologists, fire specialists, economists, operations researchers, sociologists, forest recreation specialists, geographers, and others--and a multifunctional approach with close coordination. A fairly large, "in-house" research program seems highly desirable as a framework into which cooperative research with universities and others could be fitted most productively. To make really adequate progress simultaneously on both social and ecological problems, the program must be fairly large.

This effort must have a strong mission orientation so that research results from each study can be hooked up with all other studies in a cumulative fashion. Without a clear mission-oriented goal, even the most competent research, in total, will produce disconnected and diffuse knowledge and only dissipate effort and money.

A mission-oriented, integrated, multifunctional approach would lend itself well to the suggested program of broad background descriptions linked to in-depth research on critical topics in a few areas representative of certain types of wilderness.

A long-term program of carefully interrelated studies could build the needed knowledge base, brick-by-brick, and assist administrators and planners in meeting the challenge of wilderness management successfully It is unlikely that the challenge can be met successfully without this new knowledge. Can we afford failure?