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THE STATE OF ECOLOGICAL RESEARCH IN FOREST SERVICE WILDERNESS

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ABSTRACT

Research on natural processes within Forest Service wilderness areas is defined and discussed. Current wilderness research, other than recreation-oriented, is looked at in the context of ecosystem research on natural processes. Research needs are presented. The apparent lack of ecosystem research on natural processes is a result of regulations, attitude, logistics, and funding. Recommendations for dealing with these problems are made.

INTRODUCTION

The study of the natural processes of an unaltered environment has become increasingly important as humankind's effects are becoming more pervasive and apparent. Studies in laboratories and on degraded ecosystems have value, but ecological studies that collect baseline data on and improve knowledge of how natural ecosystems function is essential to appraising and mitigating adverse effects on the environment. Large natural areas, such as are provided by wilderness areas, National Parks, and research natural areas, are needed to provide the laboratories or settings for the study of truly natural processes.

Our definition of the study of natural processes emphasizes research on how ecosystems function, on the relationship of natural biological processes to the abiotic environment, and to the collection of baseline data to describe the "natural" state. This information is generally gathered in a nondestructive and non-manipulative way. What we learn is how nature functions in the absence of human interference.

Many wilderness areas provide excellent laboratories for this kind of scientific research because they contain whole drainages where land and water interactions can be studied on a range of scales; they often contain animal populations whose entire range and habitat needs are met within the wilderness; they are large enough to include a mosaic of vegetation types and ages on comparable sites; and they frequently provide excellent areas to study the natural background levels of environmental pollutants (Franklin 1981).

Forest Service wilderness areas should be playing an important role in providing these natural laboratories but, unfortunately, they are not. Research as a valid use of wilderness has not been accepted and applied. Basic ecological studies have generally not been encouraged or supported in wilderness. In this paper we examine the present and potential scientific use of Forest Service wilderness areas as it relates to understanding ecological systems and determining trends in environmental conditions. We also make some recommendations on changes in present wilderness policy.

TYPES OF WILDERNESS RESEARCH

The goals and objectives of the Forest Service Manual (2320.2, 2324.4) concerning scientific research in wilderness are aimed at protecting naturalness and diversity. This can involve two kinds of research--basic research in wilderness and applied management research on wilderness. Basic research in wilderness has broad societal applications, in this case the generation of knowledge. The knowledge may have no direct benefit to wilderness but uses wilderness as a control point. This kind of research, which includes providing adequate

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baseline data, is frequently long-term in nature and expensive.

The second type of research, applied management research on wilderness, is designed to help maintain and manage wilderness. This most often involves an assessment of effects, usually related to recreational use of one kind or another, and leads to recommendations for mitigation measures. Because baseline information on natural processes is needed to assess adequately effects on natural systems, basic research is badly needed.

PRESENT RESEARCH USE

Basic ecological research on natural processes and their response to environmental change has been limited in Forest Service wilderness. Butler and Roberts (1986) made a fairly exhaustive tabulation of research in this wilderness and found at least 50 percent of it was recreation-related; earth science accounted for 26 percent (mostly U.S. Geological Survey reports on geology of wilderness areas); botany and zoology accounted for 14 percent, other research for 5 percent, and general ecology for 4 percent. The category of general ecology relates most closely to our concern for research on natural processes and their response to environmental change.

The senior author spoke to personnel in every Forest Service Region and many National Forests in the country to ascertain (1) what research, other than recreation-oriented, has taken place or is ongoing in wilderness areas; (2) whether this research is ecosystem-oriented; and (3) what perceived research needs, other than recreation-oriented, exist. Most of the reported research can be categorized into six major topics: wildlife, fire, vegetation, geomorphology, riparian/aquatic, and atmospheric deposition.

Most wildlife research is species-specific, with studies of habitat and patterns of movement most common. Studies include research on the gray wolf (Canis lupus) in Region 9 (Eastern Region); transplants of California bighorn sheep (Ovis canadensis); movements of deer (Odocoileus spp.) and elk (Cervus spp.) herds; feeding habits of elk; autecology of the gray-crowned rosy finch (Leucosticte arctoa), mountain lion (Felis concolor), and wolverine (Gulo luscus).

Studies relating to fire history, fire effects, fire-return intervals, etc., have been done in numerous wilderness areas (Regions 1, 2, 3, 5, 8 [Northern, Rocky Mountain, Southwestern, Pacific Southwest, and Southern], and 9) with the purpose of trying to reintroduce fire into an ecosystem(s) where historically it has been suppressed. In the early 1970's an extensive fire history study was begun in the Gila Wilderness in Region 3. Fire-return intervals in ponderosa pine (Pinus ponderosa) communities were determined and the relationship of fire to succession and wildlife was studied. Fire studies are being used in the fire management plan for a particular wilderness, but many questions concerning air quality monitoring, such as defining airsheds, still need answers. Other fire studies in wilderness include the fire history of the Boundary Waters Canoe Area in Region 9, fire ecology of Coulter pine (Pinus coulteri), fire ecology of chaparral, and the relationship of burning to several rare and endangered plants.

Vegetation studies in wilderness areas have been surprisingly limited. Very little general classification of vegetation types has been done within individual wilderness areas. Region 6 (Pacific Northwest), which has a strong vegetation classification program, has discouraged its ecologists from sampling in wilderness. Permanent plots designed to follow growth and structural changes in a chronosequence of forest stands have been established in several wilderness areas in Region 6, but most of these studies were initially started in research natural areas that were eventually included in wilderness. One extensive vegetation study was done in the Three Sisters Wilderness with support from the Man and Biosphere Program. Cole (1982) classified vegetation in two drainages in the Eagle Cap Wilderness, Oregon, and discussed the value of doing it. Several California wilderness areas have been subjects of broad vegetation classifications. Studies on vegetation change in mountain meadows have taken place in Regions 5 and 6, but these have generally been in response to human damage.

Some of the most extensive research in wilderness areas is geologic, including studies of vulcanism, glaciation, and geomorphic processes. Much of this work is legislatively mandated assessments of mineral potential conducted by the U.S. Geological Survey. Some studies on erosion and large landslides have been done in Region 5.

Aquatic and riparian studies have been mostly associated with fish rehabilitation projects or fish introductions. Little work has been done in the way of classification or productivity. A National Science Foundation study, which looked at changes in aquatic community composition, production, and energy flow, was conducted on the River-of-No-Return Wilderness in Idaho.

The final category, atmospheric deposition, has recently received much attention. The U.S. Environmental Protection Agency's survey of lakes included many lakes administered by Forest Service Wilderness. Regions 2, 4 (Intermountain), and 9 have studies in wilderness on air pollution and its effect on lichens, and very general air quality studies have been begun in Regions 1, 2, 4, and 9. Some of these studies are only monitoring visual quality and have little baseline data to precede them.

Most of the research being done tends to be short-term and lacks a holistic emphasis. Although every study contributes to our overall understanding of ecological processes, baseline information on a wider range of natural processes is needed. Such studies need to be carefully designed to identify trends and improve our understanding of natural processes. A repeated series of measurements on permanent sample plots with certainty of funding is badly needed to identify trends.

Most of the support for research in wilderness is coming from non-Forest Service sources. The U.S. Geological Survey supported all the mineral classification work. The Environmental Protection Agency, the Department of Energy, and the National Science Foundation have supported much of the atmospheric deposition research. Funds for most of the research work reported in California wilderness areas have been provided by State universities.

In contrast, the National Park Service has been more accommodating in opening its wilderness areas to gathering baseline ecological data and studying natural processes. As an example, an ecosystem study on the South Fork Hoh River in Olympic National Park has provided useful information for managed landscapes outside the park as well as for park management. One of the research results on the South Fork demonstrated the importance of off-channel habitats to fish production (Starkey and others 1982). This has led to changes in attitude outside the park where anadromous fisheries and timber harvesting occur together. Two large elk enclosures erected in 1978-79 have provided dramatic evidence of the effects of elk on vegetation composition and structure. Additional ecosystem research has been added to the Hoh drainage as part of the National Acid Precipitation Assessment Program, including quantitative studies of nutrient cycling.

Specific research needs were repeatedly mentioned by Forest Service personnel. Everyone agreed that basic inventories of plant and animal populations are needed. The most commonly mentioned topic was fire and its role in natural ecosystem processes. This topic has many aspects: vegetative structure and composition, successional processes, nutrient dynamics, and air quality. Most people seemed to agree that we need to know more about succession to understand the effects of grazing and fire suppression. Several people expressed interest in studies of other natural perturbations such as insect epidemics. Diversity was another topic that was often mentioned. Although the term was not usually defined, the primary concern was lack of knowledge about the effects of management activities on diversity. Finally, air quality and atmospheric deposition were stated as major research needs. This topic is quite involved and ranges from the complexities of acid rain studies to merely defining the airshed for a particular wilderness. Overall, the discussion with Forest Service personnel indicated consensus on the need to understand natural processes occurring in wilderness and a concurrent need to integrate this information into wilderness management.

TRENDS IN RESEARCH USE

Scientific use of Forest Service wilderness is minimal, especially as it relates to the natural functioning of ecosystems. Because there is no system to record what is taking place, trends in research use are extremely hard to discern. There does not appear, however, to be any great increase in research use since the first wilderness areas were established. As discussed above, most research tends to come about in reaction to an adverse effect on the environment. The wilderness areas most commonly used for research are: (1) in California, especially the heavily used areas near Southern California; (2) areas close to universities; and (3) wilderness areas in Region 1 where most wilderness researchers in the Forest Service reside.

Butler and Roberts (1986) found that larger areas received greater research attention, and that use increases from dry to wetland areas. They also state that wilderness management concerns tend to dictate the dominant research topics. Because the Forest Service has managed its wilderness primarily for recreation, research has been primarily directed toward recreation although recreation yields no direct benefit to wilderness. Finally, people in Regions 1 and 5 feel that inaccessibility of wilderness is a major deterrent to researchers.

PROBLEMS AND RECOMMENDATIONS

There are serious long-term implications to society and to wilderness management because of the low level of ecosystem-based research. Though the wilderness system is large and represents an impressive commitment, society is not accumulating the knowledge necessary to understand the basic processes operating in natural ecosystems and how these processes are affected by environmental changes. This has several consequences for wilderness preservation. First, management is not getting the kind of information it needs to identify threats to wilderness and to develop management practices consistent with the wilderness concept. Second, scientific values as a justification for maintaining and expanding the wilderness system will be hard to substantiate.

Why, then, isn't more wilderness research being done on Forest Service land? First, we must look at the formal limits imposed by Forest Service regulations and then at other limits.

Regulations and Non-Conforming Uses

Justification for the scientific use of wilderness is documented in numerous Federal statutes and has been discussed at length in articles and at symposia (Lucas 1986, 1987). The 1964 Wilderness Act, the 1969 National Environmental Policy Act, the 1974 Resources Planning Act, and the 1976 National Forest Management Act all endorse the use of wilderness for scientific research, either in the context of an expressed use or for evaluation of management practices. The Forest Service manual direction is more specific than the legislative acts, and this specificity can be restrictive in nature. The research must be shown to be compatible with the preservation of the wilderness environment; research proposals should be reviewed to ensure that areas outside the wilderness could not provide similar research opportunities; and exceptions to the equipment restrictions are to be made only if the research is essential to meeting the minimum requirements for administering the wilderness. These restrictions pertain to any kind of research.

Wilderness legislation has allowed for too many conflicting or non-conforming uses that have created problems for wilderness research. In some instances domestic livestock grazing has compromised the naturalness of meadows and riparian zones to the point where the "natural" community no longer exists. Hunting and trapping may detract from the potential scientific value of studying natural populations of game animals, and may have subtle effects on the populations of nongame animals. Fish stocking of previously barren lakes has affected the trophic structure of many lakes. Human traffic has sometimes caused the introduction of exotic species (Franklin 1987).

Regulations relating specifically to scientific use are also a problem. Marking of

permanent sample plots with stakes or re-bar, essential for future relocation, has generally been discouraged. Electronic equipment that is necessary for many types of research but requires a power source is prohibited. Shelters for meteorological equipment or temporary gauging stations are generally discouraged. The inaccessibility and ruggedness of many wilderness areas can make sampling much more difficult. Often heavy equipment use and the need to expedite transportation of samples is prevented or inhibited by distance and prohibition of any kind of motorized equipment. However, in some instances the use of motorized equipment, for instance helicopters, may have the least impact on the wilderness resource. In essence the very best equipment and methods of research on natural processes often cannot be currently used within wilderness boundaries under present policies.

Other Problems

Three additional problems concerning the lack of scientific use of wilderness are attitude, logistics, and funding. Attitude is, perhaps, the most serious problem and the hardest to deal with. To begin with, scientific research on natural ecosystem processes has not been highly valued as a part of management planning. Managers have traditionally only supported research to solve their immediate problems. Such studies tend to be short-term and lack a holistic perspective. Long-term data that do not serve their immediate needs are viewed as too costly and too vague in objectives and likely results. Scientists, on the other hand, have traditionally been unappreciative of management's problems or concerns, have viewed managers as only interested in short-term studies, and are often ignorant of wilderness regulations. This mutual misunderstanding has done little to further scientific knowledge and has certainly done a disservice to wilderness management and preservation. What is lacking is a strong advocate for scientific research on natural systems and its relation to wilderness management problems.

In justifying ecosystem-based research in wilderness, one is often forced to define whether this is applied management research on wilderness or basic research in wilderness. The latter category is usually thought to have no direct benefit to wilderness, unlike a study on user effects. Wilderness as a control site, as a baseline ecosystem that can tell us something about the world around us, is currently not what wilderness is perceived as providing, if the level of support is any indication.

Logistics is complicated in wilderness areas because of inaccessibility and ruggedness of the terrain. Butler and Roberts (1986) found that the larger wilderness areas received the most research use, but our telephone survey indicated that large size can also be a deterrent. Many wilderness areas are in terrain that is physically very difficult to get around in, especially if you have to carry more than your own personal gear.

Funding is a perennial problem that severely restrains research programs. Substantial research money is often spent on logistics, out of concern for maintaining the "wilderness character," which then decreases the amount available for actual research. With less money available for sampling, the scope of the research is reduced and the level of uncertainty about one's data often increases. Managers and scientists might have differences of opinion on what level of uncertainty is acceptable. Who decides the balance? Equitability is also an issue. East coast wilderness managers believe that the vast majority of money that is available for research in wilderness goes to Western wilderness areas. When funding is limited, resources are generally allocated to immediate, critical (a perception) problems.

Recommendations

How, then, can these issues be dealt with? Changing attitudes is the major challenge. What is needed is a strong sense of advocacy, at national and regional as well as individual forest levels, for scientific research on natural ecosystems that includes wilderness management problems as part of an integrated package. Mechanisms need to be developed to bring managers, at all three levels, together with scientists to determine research needs and options, and to formulate long-term plans. Managers need to communicate to scientists

their needs and concerns, while attempting to be more flexible in their regulations and time frames. Scientists need to educate managers to the potential benefits of long-term ecological research, while showing interest and concern for managers' immediate needs. Users need to provide feedback and support to both groups. They need to make it clear that they care about the naturalness and integrity of the wilderness ecosystems, and they need to understand that they are also part of the problem. A possible mode of advocacy has appeared in Region 1. A wilderness ecosystem committee has been formed that includes managers and scientists from the Forest Service, National Park Service, Fish and Wildlife Service, State Parks, State Game Departments, Intermountain Forest and Range Experiment Station, and the University of Montana.

A fresh look at wilderness regulations is in order. Grazing, hunting, trapping, and fish stocking of lakes needs to be reevaluated in the context of the need for monitoring of long-term baseline data and research on natural processes. The use of shelters, permanent sample plot stakes, and occasional motorized equipment should be permitted after considering the potential benefits of the research. A case in point involves a large study done by the Rocky Mountain Forest and Range Experiment Station. The study involved developing guidelines to assess current conditions of wilderness ecosystems as part of a larger program to protect air quality as mandated in the Clean Air Act of 1977. The research was ultimately sited outside wilderness because of the resistance to power-driven instrumentation, instrument shelters, etc. In commenting on the problem of acquiring exemptions from the regulations, the scientists state "In all likelihood, then, a request for an exemption is likely to be refused unless it can be demonstrated unequivocally (emphasis added) that the data to be gathered under the exemption are absolutely necessary, and all possible alternatives to the exemption have been considered, and the data cannot be gathered in any other manner" (Fox and others 1987). Yet their research was supposed to yield information on current conditions within wilderness ecosystems. Inflexibility in regulations should be weighed against the potential scientific information made available to managers. At the same time, scientists need to adopt new techniques for data gathering.

Perhaps specific areas within wilderness might be designated for ecosystem research. In the West, research natural areas have been identified in wilderness with this specific purpose in mind. Designated use does not run counter to wilderness direction; wilderness areas have many kinds of designated uses--camping areas, grazing areas, stock-use areas, stocked lakes for fishing, etc. Wilderness management zoning is not a new idea (Haas and others 1987).

Regarding the last issue, no one will be surprised to hear that more money is essential. Scientists and managers need to educate decision makers about critical long-term problems. Much can be learned from the National Park Service which has a much better record of research with an emphasis on understanding natural processes. The NPS often has proportionately more research staff and money dedicated to this pursuit. For instance, Glacier National Park has 10 scientists on its staff concentrating on wilderness- ecosystem process research. Most ecosystem research occurring in Forest Service wilderness has relied on outside support such as the National Science Foundation. The Service itself needs to provide more support for research of this kind. Service support also needs to include more than just money. Ways of expediting National Science Foundation, university, and other Federally funded research should be pursued, including changes in attitude as well as more flexible regulations.

CONCLUSIONS

The Forest Service Manual (2320.2) lists five objectives for wilderness management. Number 4 states "Protect and perpetuate wilderness character and public values including, but not limited to, opportunities for scientific study, . . .", and number 5 states "Gather information and carry out research . . . to increase understanding of wilderness ecology, . . ." Both statements stress scientific study of ecological processes is both valid and necessary. Such research involves measurement of long-term processes, whether it is changes in environmental conditions, ecosystem succession, or population dynamics

ecosystem succession, or population dynamics of various organisms. Carefully planned and integrated, it can provide a holistic view of wilderness ecosystems and improve management for wilderness attributes. Very little of such work is being done. Quite simply, Forest Service wilderness areas are under-utilized for ecosystem research, considering the diversity of ecosystems and the vast acreage that is rarely used by recreationists.

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