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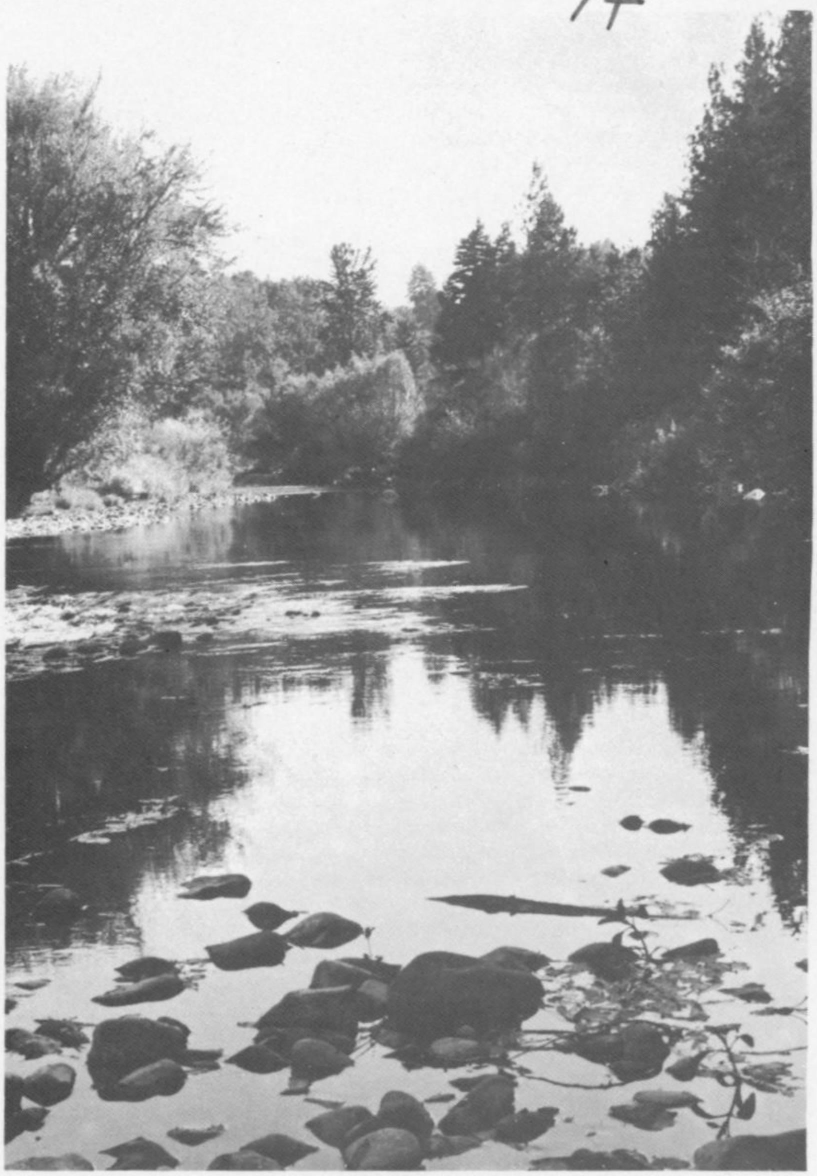

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Scientific Reserves in the Pacific Northwest and their Significance for Ecological Research

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Abstract

Progress in development of a system of scientific reserves (Research Natural Areas and Experimental Ecological Reserves) in the Pacific Northwest is reported. Such reserves are essential as field laboratories for ecological scientists and offer numerous advantages for research projects over unprotected sites. If such reserves are to be retained and the system expanded, scientists must make fuller use of them in the future.

Introduction

Field sites, specifically dedicated to scientific research and containing representative examples of our important ecosystems, are essential for continued progress of basic and applied environmental and ecological sciences. Since all the world's lands and ecosystems are, to at least some degree, laboratories for field scientists, why, then, is it so essential that we have tracts where science and education are the primary land directives? Why will this increasingly be the case in the future?

First, modern ecological research frequently requires large data bases to test basic hypotheses about the structure and function of ecosystems and biotic communities. Even in areas of applied ecology, such as silviculture or range management, scientists must increasingly consider effects on other resource values and on nontarget organisms. Hence, extensive knowledge of the environmental and biologic features of the ecosystem under study is a necessary prerequisite in both basic and applied research projects.

Second, sites which are protected for long periods of time are essential

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for many small- and large-scale experiments. Installation of research projects on properties where science and education are not the primary goals can result in loss of equipment, data, or perhaps the unscheduled termination of an entire experiment. Related to this need for protected sites are the long-term data sets essential to many ecological and environmental studies. Adequate tests of important ecological hypotheses and of certain management practices require observations which are carried out over many years. Some examples are studies of successional phenomena, growth responses after thinning, and nutrient losses after forest cutting. Long-term data sets are equally essential for sorting out interseasonal or short-term variations from long-term trends.

Third, scientists and agencies sponsoring research must consider financial efficiencies in the conduct of research. A wide array of research projects have common data needs. For example, climatic data and floristic and structural descriptions of study sites are typically basic. By concentrating studies in an area where such information is being collected or is already available, substantial efficiencies among projects are possible, and, if these studies are conducted collectively or by specialists, the data are often better than the individual scientist could collect for himself.

Finally, when several scientists focus on the same study area, serendipitous discoveries can result. An example is found in the alder-conifer study plots at the Cascade Head Experimental Forest where studies of nitrogen fixation, soil chemistry, growth and yield, soil microbiology, etc., were conducted independently. Frequent discussions occurred among the scientists as they carried out their field and laboratory studies of this common site, and from the entire array of data came the hypothesis that red alder may adversely affect survival of the very destructive laminated root rot *Phellinus weirii* (Trappe *et al.,* 1968, Trappe 1972). Specific tests of this hypothesis and its components are now underway which may have important biological and land management implications.

In this paper I will try to specify the types of scientifically dedicated areas that are needed in the Pacific Northwest and what is being done to create them. Finally, I want to leave the reader with an understanding of his responsibilities in maintaining such a system of scientifically dedicated sites.

Types of Areas Required

There are two principal types of essential scientific reserves. The first and most familiar is the natural, baseline, or control area, typically labeled the Research Natural Area (RNA) or, in the nomenclature of the Federal Committee on Ecological Reserves, the Natural Ecological Reserve. Large numbers of this kind of area are necessary for a representation of each important and unique terrestrial, freshwater, and marine ecosystem found in a particular region. Generally, the RNA is of modest size, averaging about 400 ha, although occasional reserves may be 10,000 ha or more. The most important feature of RNA's is that natural processes are allowed to proceed unhindered; human interference is minimized. Neither managers nor scientists are allowed to significantly disturb such sites. Obviously, experiments involving substantial manipulation are not appropriate.

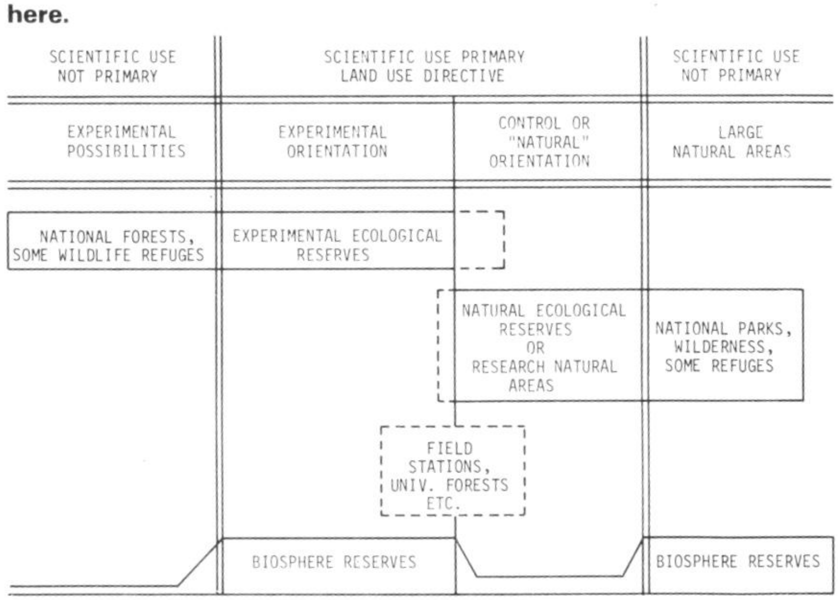
The second essential category of scientific reserve is the experimental area or, as it is coming to be known, the Experimental Ecological Reserve (EER). As in the case of the RNA's, these are sites which are permanently dedicated to scientific and educational purposes. Generally, they are necessarily larger areas to allow for manipulative experiments involving entire stands, communities, or watersheds. Most EER's are broadly representative of major landscape segments or mosaics within a biotic province. Included within EER's are areas set aside as controls, which may or may not be recognized as RNA's. Among the best potential sites for inclusion in a national system of Experimental Ecological Reserves are the reservations of the Energy Research and Development Administration, the Experimental Forests and Ranges of the Forest Service, and some of the Agricultural Research Service's Experimental Stations.

These two types of areas are obviously not the only sites which are important and useful to scientists involved in ecological and environmental research. As I said earlier the whole world is, to a degree, the ecologist's laboratory although he has little control of the treatments applied! Many studies by their nature must be conducted in the "real world," as opposed to the controlled conditions of the scientific reserve, or require samples taken at tens, hundreds, or even thousands of widely separated locations.

Wilderness and National Parks, as well as portions of Wildlife Refuges, are a specific set of areas which provide outstanding field sites for many kinds of ecological and environmental research. Certain studies will be possible only on areas of this type, such as research on natural populations of the larger ungulates and predators. However, conservation and recreation, not scientific research, are typically the primary land use directives (Fig. 1). There may be significant logistical problems and a limited capability for experimental research. In our large Wilderness Areas and National Parks, obvious focal points for scientific study may be lacking, and mutual benefits, such as might result from common study areas or data bases, will not be realized. As an example, scientists studying Pacific silver fir-western hemlock forests in Olympic National Park could work for 10 years and never encounter each other or utilize the same stands. This is one reason that the National Park Service sometimes designates Research Natural Areas on smaller segments of its properties. Ordinary National Forest lands may also be appropriate for many kinds of research, but again, science is not the primary land use directive and the scientist must adapt his project to current and future uses of these lands.

FIGURE 1.

Experimental and Natural Ecological Reserves are the major categories of scientifically dedicated land; their relationship to each other and some other land designations are illustrated here.



Some additional field sites dedicated primarily to science or education have limited regional or national importance. These include many woodlots, ponds, or other "natural areas" located on or near university or college campuses, which are used in undergraduate educational programs. The classical field station is another example. Unfortunately, many of the original academic field stations have a small land base, limiting opportunities for experiments or long-term studies, while they are relatively rich in buildings and other improvements which have high maintenance and operating costs.

If we can agree that ecological and environmental research requires a representative series of Experimental and Natural Ecological Reserves, what is needed to establish and maintain such a system? I wish to address three essential elements: development of a conceptual plan, identification and dedication of areas, and use of established areas by scientists. Where are we with regard to these three elements in Oregon, Washington, and Idaho?

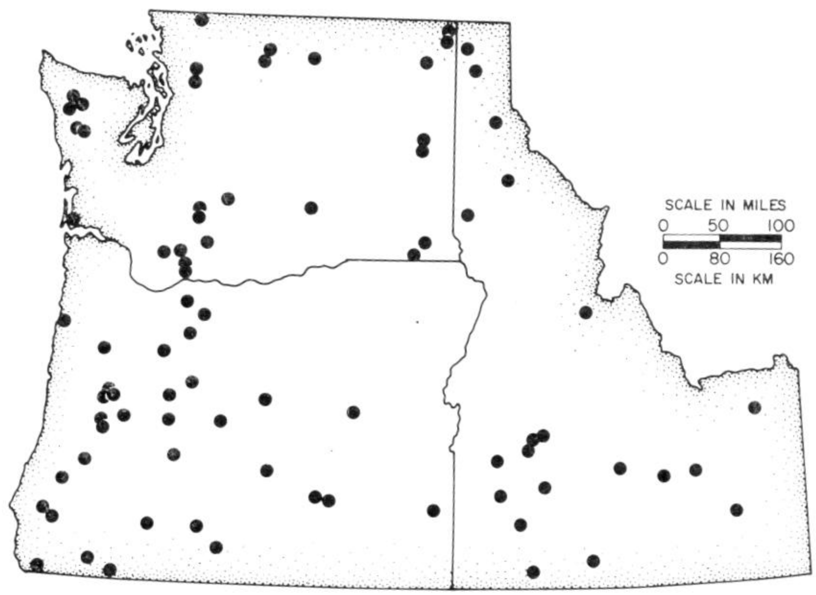
Research Natural Areas

We are making very good progress in the Pacific Northwest in defining needs in the form of a conceptual plan and in identifying and dedicating areas. We have a large number and acreage of established Research Natural Areas, mostly on federal lands. Areas are being selected and established so rapidly that it is hard to keep track of the numbers, but my latest figures indicate there are 80 areas totaling approximately 84,800 ha. The distribution of the existing RNA's on federal lands is shown in Figure 2. Most are described in the book "Federal Research Natural Areas in Oregon and Washington" (Franklin *et al.,* 1972) and later supplements. State programs of natural area preservation are just getting underway. The state of Washington has a reserve in the Mima Mounds as well as two smaller areas. In Oregon, many candidate areas have been identified and are being reviewed. In addition to preserving numerous areas, The Nature Conservancy has undertaken a very extensive inventory, particularly in Oregon.

Development of a master plan for the regional system of Research Natural Areas is at least as important as the establishment of areas, particularly at this stage; it provides the overall guide for selecting and evaluating sites. Any viable plan must be developed jointly by the agencies and institutions who have responsibilities for dedicating and managing these properties and by the scientists who will use them. Such a master plan has been developed for the RNA system in Oregon and Washington (Dyrness *et al.,* 1975), and a preliminary plan has been developed for Idaho (Wellner and Johnson 1974). I would like to emphasize that these plans are the combined efforts of scientists and land managers; this collaboration is essential because any plan has to be acceptable to both groups if it is to function as the basic guide for selection and establishment of additional RNA's.

FIGURE 2.

Distribution of existing federal Research Natural Areas in Oregon, Washington, and Idaho.



The master plan for Oregon and Washington described in "Research Natural Area Needs in the Pacific Northwest" (Dyrness *et al.*, 1975) begins by defining the essential elements or "cells" that should be represented within protected RNA's in each of several physiographical provinces. Cells may be ecosystems, community types, or even individual organisms. Included are freshwater, terrestrial, and marine cells. Next, the cells already represented within established RNA's are identified. The remainder represents the elements or cells still to be identified and protected within the RNA system.

The experts involved in the workshop identified 772 cells within Oregon and Washington: 362 terrestrial, 180 freshwater, 94 rare and endangered animals, and 136 marine and estuarine. The existing RNA system fills approximately 92 terrestrial cells, 18 freshwater cells, and 7 rare and endangered animal cells. By aggregating unfilled cells into groups which can probably be included within a single RNA, it is estimated that approximately 300 additional RNA's will be needed to provide a minimal system for Oregon and Washington. It should be noted that the plans or lists are not final. But they do provide a basic outline for identifying candidate RNA's as part of comprehensive land planning activities such as are underway over much of the region. In fact, the plan is being extensively used by federal agency land planners and RNA workers. It is also being used in The Nature Conservancy and state programs to search out and evaluate potential RNA's.

Experimental Ecological Reserves

A master plan for Experimental Ecological Reserves in the entire United States is being drafted by The Institute of Ecology (TIE) under a grant from the National Science Foundation (NSF). This grant arose out of a need within the NSF to develop a rationale and plan for support of field stations. Many scientists and NSF officers have felt for some time that field research sites needed some kind of support, but there was no basis for determining which sites should be supported and at what levels.

TIE is charged with several tasks. Determining what should exist in the way of EER's in the context of biotic regions and national scientific needs is one major job. Identification of essential categories and levels of support and evaluation of existing experimental areas and field stations are other major elements in the study. One early definition of an Experimental Ecological Reserve is that a reserve "is a component of a comprehensive series established to facilitate ecological research. Individual reserves will be representative of a major ecosystem type, natural or man-modified, and will be dedicated to experimental research with experimental modification permitted as is consistent with the maintenance of the Reserve as a long-term research base that contains unmodified control areas."

TIE is already well along on this study, and a particularly interesting aspect of it has been the inventory and evaluation of existing experimental reserves and field stations. To evaluate areas, TIE developed a series of rating criteria for ranking the inventoried sites. Site quality is considered most important and includes the degree to which a site is representative of a recognized biological classification unit, the adequacy of control areas, size (including specific attention to availability of homogenous areas or replicated experiments), and landscape heterogeneity. The scientific data base at a site, current level of research, and quality of associated staff are criteria of secondary importance. Third in the evaluation criteria is the existing logistical capability of the site including various improvements and facilities.

A cursory examination of a potential EER system results in the not too surprising discovery that many of the best candidates are existing federal experimental reserves, such as the reservations of the Energy Research and Development Administration, Experimental Forests and Ranges of the Forest Service, and some Experimental Stations of the Agricultural Research Service. Obviously there are few institutions outside the federal government that can afford to acquire and dedicate large tracts of land to scientific pursuits. Many existing federal areas are large and excellent representatives of our most important landscapes and ecosystems. The NSF is seriously considering support of some of these federally controlled properties as national field research facilities. Grants would be made to an appropriate associated university and not to the administering federal agency. Funds would be used primarily to provide baseline data and logistical support for basic academic scientists conducting projects on the EER but not for their specific research projects. An outstanding opportunity potentially exists for close cooperation between applied research programs, which are funded by the agencies, and basic research programs, funded primarily by cooperating universities and the NSF.

Here in the Pacific Northwest, we are extremely well blessed with candidates for EER's. Some of the areas inventories by the TIE are shown in Figure 3. Also shown are additional candidates which were not included in the initial inventory.

FIGURE 3.

Data from these areas in the Pacific Northwest were used by The Institute of Ecology as part of the study of potential Experimental Ecological Reserves (solid circles); some additional sites may have comparable potential (open circles).

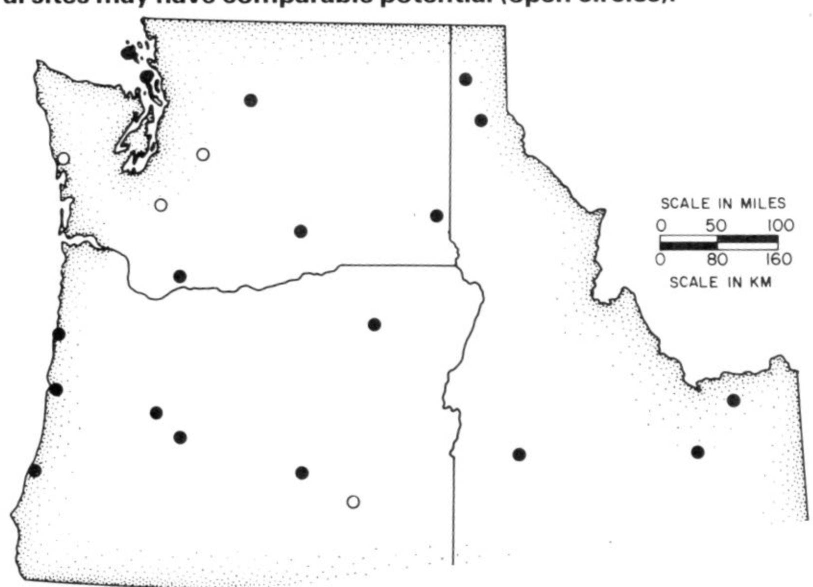
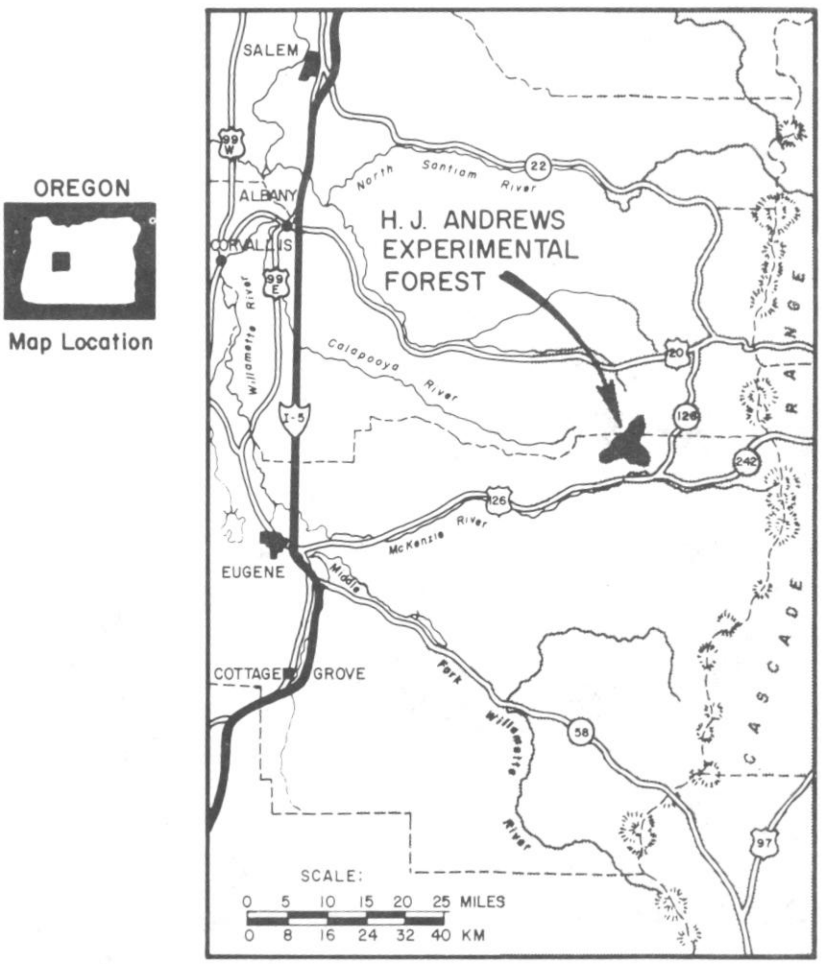


FIGURE 4.

Location of the H. J. Andrews Experimental Forest in western Oregon; this area has been proposed as a national field research facility by Oregon State University and the U.S. Forest Service.



Since we want an EER system useful to academic as well as agency scientists, an example may be appropriate to illustrate how a national EER on federal lands would work. The H. J. Andrews Experimental Forest in western Oregon is a 6,050 ha property on the Willamette National Forest (Fig. 4) which is administered by the Pacific Northwest Forest and Range Experiment Station. The Experimental Forest provides outstanding representation of mature and old-growth Douglas-fir, western hemlock, and true fir forest ecosystems as they occur on the western slopes of the Cascades (Fig. 5) and of typical stream systems of up to fifth order. The forest has a long history of hydrologic, silvicultural, limnologic, ecosystem, and other ecological studies which provides an extensive data base for future environmental research programs. In addition to the substantial past and current Forest Service research on the site, the H. J. Andrews is one of the intensive study sites for the Coniferous Forest Biome and a major study site for large, independent NSF-sponsored projects on forest canopies and stream processes.

FIGURE 5.

The H. J. Andrews Experimental Forest provides outstanding examples of virgin Douglas-fir-western hemlock ecosystems.

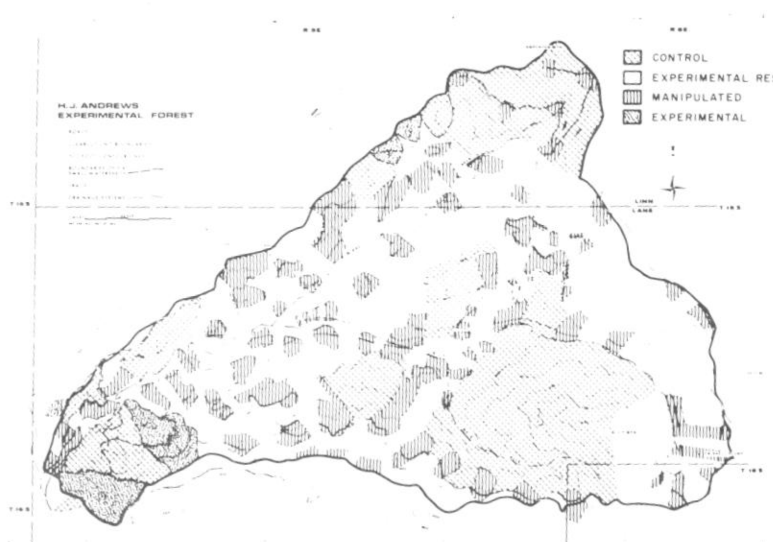
A proposal requesting support of the H. J. Andrews Experimental Forest as a national field research facility or EER has been submitted to the NSF. Oregon State University and the U.S. Forest Service developed the proposal jointly. If implemented, the property will be jointly administered. Directors of the reserve will be advised by a multidisciplinary scientific Site Advisory Committee, broadly representative of universities and other research-oriented institutions throughout the West. NSF support will be used to improve the quality, amount, and accessibility of basic biologic inventory and environmental monitoring information available to scientists conducting research projects at the site. Improvements in logistical support for scientists using the property are also a component, such as housing, laboratory space and equipment, and transportation.

The land base at the H. J. Andrews Experimental Forest would be allocated into several categories to increase its long-term scientific potential (Fig. 6). Specifically, substantial portions of the Experimental Forest are recognized as Control Areas which will not be subject to destructive research or to destructive manipulation. Approximately 50 percent of the Experimental Forest is being placed in the category of Experimental Reserves. These are virgin lands which will be retained in an unmodified state until there is a legitimate research project which requires experimental manipulations of such areas. Manipulative Areas are portions of the Experimental Forest where we will try to create new kinds of communities which might not otherwise be available, such as an age-sequence of young conifer forests of varying composition on different habitat types. On the Manipulative Areas, we are trying to anticipate communities or ecosystems which will be essential or desirable for basic and applied research projects in the future. A fourth, minor category of land is the Experimental Area. These are sites that have been experimentally treated and where the recovery processes or long-term responses are under study.

Scientists wishing to use an EER, such as the H. J. Andrews Experimental Forest and its facilities, would be required to submit a research proposal to the Site Directors, which would indicate the nature of their proposed research and the lands, facilities, and existing data they wish to use. When limited commitments of facilities or limited experimental manipulations are anticipated, the Site Directors will approve the project and turn over the coordination and responsibilities to the Site Manager. When research projects involve major use of the facility, day base, or land, the proposal will be reviewed by the Site Advisory Committee to determine its compatibility with the long-term objectives for the EER. Please recall that the reserve itself will not be funding research projects but simply accommodating them. Proposals involving extensive manipulations of the Experimental Reserve would impact future potential of the H. J. Andrews Experimental Forest by using up virgin areas available to future scientists.

FIGURE 6.

Proposed allocation of the H. J. Andrews Experimental Forest lands into Control Area, Experimental Reserve, Experimental Area, and Manipulative Area.



Responsibility of Ecological and Environmental Scientists

Establishment of RNA's and EER's involve large investments of land and related resources exclusively for scientific research. They also provide locations where scientists can benefit from, as well as contribute to, an accumulated data base and activities of other scientists.

Despite such advantages, too many scientists continue to pursue their work at the most convenient location. Ecologists are notorious individualists; they often pick study areas without regard to repeatability, utilization of results, or interactions with other scientists, or in many cases, even how representative their site is of a particular ecosystem or community. They complain when their study areas are destroyed and ask for additional reserves, but they typically do not use existing protected sites even when appropriate.

My goal is to try to impress upon you, as an ecological and environmental scientist, the necessity and desirability of using those properties which have been established for scientific purposes. We are fast approaching the time when, if we do not make full use of these areas, we seriously risk losing them. If scientific reserves, including both RNA's and EER's, are not effectively utilized by scientists for their research, then the resource that they represent may well be diverted to other uses, to the significant detriment of science, both present and future. It has been a hard struggle by many scientist to bring our system of scientific reserves to its present state and to lay the groundwork for future expansion. But it will come to naught, if scientific use of existing areas does not increase.

As the NSF begins to support selected sites as national field research facilities or EER's, the need for scientists to make the fullest possible use of these sites increases. These NSF funds will be designed to provide basic data and logistical support for academic scientists engaged in research projects at such sites. If scientists do not make good use of these national field facilities, then organizations such as the NSF will have no alternative but to conclude that they are not needed and utilize their limited dollar resources in other disciplines.

In conclusion, ecological and environmental scientists must be aware of the scientific reserves which have been established specifically for the conduct of research, and we must use such properties whenever appropriate. If we do not unite in our support of such reserves, as demonstrated by our use of them, our discipline will be poorer as a result, and we may find ourselves without protected sites on which to conduct future research.

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