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Why a Coniferous Forest Biome?

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Abstract

This introduction to the symposium outlines some of the reasons large integrated ecological research programs have been deemed necessary despite problems inherent in such "large science" programs.

The Coniferous Forest Biome program is an interdisciplinary research effort concerned with the structure and functioning of coniferous forest and associate aquatic ecosystems, particularly as they occur in western North America. Initiated as a part of the U.S. International Biological Program it is one of six biome programs organized in major biotic-environmental divisions or regions of the United States—Deciduous Forest, Grassland, Desert, Tundra, Tropical, and Coniferous Forest. The first major funding of the Coniferous Biome occurred in September of 1970, and there are now over 100 scientists from a total of 15 universities, national laboratories, and agencies involved in the program.

Many aspects of this large and vital research program will be described in papers which follow. However, questions continue to arise, such as, Is this program necessary? What differentiates the Biome efforts from the numerous existing research programs on coniferous forests, both large and small? Why has this "big science" effort been mounted?

So, before looking in detail at the Biome's research activities, I'd like to share with you some of my views on the need for and importance of the Biome program. These views are not all inclusive nor necessarily shared by all involved in the program.

To get close to home, let's consider first the increasingly complex nature of problems facing forest land managers. Questions used to be relatively simple: What cutting system will regenerate a desired forest type? What effect do different thinning or fertilizing regimes have on production of merchantable timber? What herbicides will most effectively permit reforestation and discourage brush on cutover areas? Such questions are still interesting and important. However, many of the more critical land management questions reach far beyond the relatively narrow confines of maximizing production of goods from forest lands: How do different cutting methods influence the flow and quality of water and, further, the characteristics of aquatic communities? What effect does fertilization have on the nutrient content or fertility of the water draining from the treated forest land? What happens to various pesticides when applied to the land—how fast are they degraded, where do they accumulate, and what effect do they have on nontarget organisms and the eco-

system as a whole? And, if the biological and physical questions were not sufficiently difficult (and they are), overriding economic and social considerations further compound the complexity of land management problems.

The basic knowledge of natural science required for rational resolution of some of the larger questions has thrust some new and difficult demands on the scientific community. Of course, large amounts of information are required; we often hear of an information explosion but, in fact, we are faced with a "demand" explosion—available data are totally inadequate to meet the information requirements of policymakers. More important, however, is the need for new kinds of information, particularly information on linkages between the parts of forest ecosystems, such as land and water, and between economics, sociology, and natural sciences. In effect, information is required which involves the links or relationships between the traditional units or disciplines of scientific attention and organization.

In addition to the study of linkages among different components of ecosystems, we are searching for properties that are unique to whole systems. We are asking how much time is required for an ecosystem to fully recover following disturbance, how many components are redundant in the system, what are the major selection pressures to which ecosystems respond, and finally, are we forcing ecosystems to adapt to changes faster than is possible?

It is also apparent that research programs must be planned so as to anticipate unforeseen questions and needs as well as answer immediate questions. In other words, scientists must work toward development of general principles and models which will allow us to predict from past research what will happen in a new situation which has not yet been a subject of detailed study. Examples might be the use of basic models to anticipate the effect of a cutting system in a new forest environment or of a newly developed pesticide on the animal component of a forest stand. The importance of this capability for generalization is related to another recent phenomenon, the insistence that scientists provide immediate "best" answers to questions based on present available knowledge; society is unwilling to wait for long periods for "final" solutions.

These increased demands on the scientific community have to be met without the great increases in money and manpower experienced in the earlier postwar period. Since scientific resources are limited, they must be utilized more efficiently to meet society's needs for problem-solving information. Relevance and efficiency have become important considerations in planning and funding research programs.

In many respects, the demands outlined above run counter to the traditional ways of doing scientific research. Science has been strongly disciplinary in character with the greatest rewards going to the specialist who pursued his field in great depth. Even the applied scientist has tended to have a narrow focus looking, for example, at the effect of a cutting method on regeneration or thinning on wood yields, not at the overall effects of such treatments on ecosystems.

From another viewpoint, science has been likened to an edifice of bricks gradually built up by the effort of many individual scientists. Unfortunately, there has been a strong tendency for each scientist to produce bricks of a dimension, shape, and material primarily of interest to him. Furthermore, at least in ecology, we have lacked overall blueprints for our edifices which would provide direction as to the kinds and number of bricks we need.

There can be no questioning the need for strong basic research programs; they are essential to the advancement of science and human knowledge. Traditional viewpoints and approaches do not adequately meet a great many of today's needs, however. Consequently, the scientific community is being forced to restructure a large part of its efforts, partially from a sense of its own responsibilities and partially in response to society's pressures. Nowhere is this more evident than in the fields of natural resources and ecology. New programs are interdisciplinary efforts which try to overcome inadequacies in past research efforts. Resources are concentrated on critical areas related, either directly or in-

directly, to solution of major natural resource problems.

The Coniferous Forest Biome program is one of these integrated, interdisciplinary efforts. It has as its overall objective an understanding of how materials, such as water and nutrients, and energy enter, move through, and leave coniferous forest ecosystems, including both the terrestrial and aquatic components. The Biome program shares some common characteristics with many other large new ecological research programs: (1) It involves groups of scientists from many different fields working together toward some common goals. (2) It has a "systems" orientation; it is concerned with all parts of the ecosystem, its total behavior, and the linkages between the various components, not with a single piece. (3) Mathematical descriptions or models of the various processes, subsystems, and total ecosystem are a key to organization and synthesis of the effort. Conceptual models provide the framework for structuring the research effort and determining data needs. (4) Continuous communication between the scientist participants, including sharing of data, is an essential feature. The efforts progress via the constant interchange between scientists, between modeling and the field and laboratory research.

In our symposium, we will try to introduce you to the kinds of research being conducted under the auspices of the Coniferous Forest Biome. The papers range widely in scope from general presentations on the conceptual basis for major program segments to results of relatively narrow research projects. Unfortunately, it is too early to provide any major synthesis of activities; this summer will be the first field season of essentially full funding. We have tried to emphasize the new concepts, techniques, and data which are emerging from the Biome's efforts. We hope that the "samples" of activities and philosophy which follow will make clearer what the Biome is trying to do and how we are going about it.

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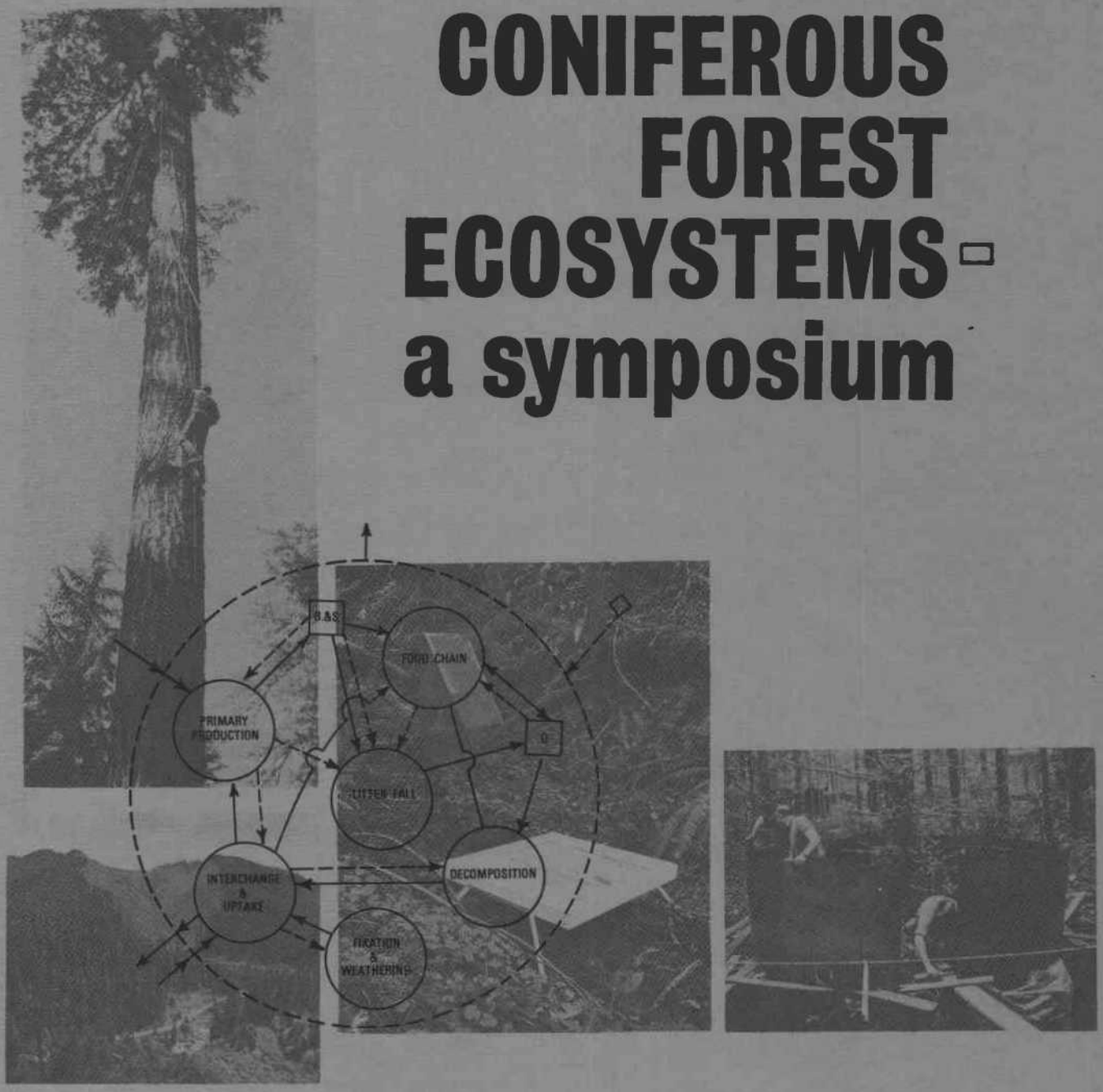

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