



# **THE ECOSYSTEM CONCEPT IN NATURAL RESOURCE MANAGEMENT**

Edited by George M. Van Dyne

COLLEGE OF FORESTRY AND NATURAL RESOURCES  
COLORADO STATE UNIVERSITY  
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**The Ecosystem Concept  
in Natural Resource  
Management**

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## Preface

Man's rapidly developing technology provides him with increasing ability to manipulate the environment, e.g., traces of pesticides are now found in organisms throughout the world. But man has not had sufficient understanding of the many long-term consequences of environmental manipulation. In part, this has been because he often has not taken an ecological viewpoint: but the ecological basis of natural resource management is becoming more clearly understood, especially in multiple-use management of natural resources to increase productivity. Understanding the ecological basis of productivity in nature means understanding ecosystems. An ecosystem results from the integration of all of the living and nonliving factors of the environment for a defined segment of space and time. It is a complex of organisms and environment forming a functional whole. The study or management of such complexes requires more than one individual; no one man can encompass all of the required specialties and knowledge. This has led to the concept of interdisciplinary teams for research on and management of natural resource ecosystems. This diversity of skills and specialties is reflected in the variety and kinds of training received by the authors of the chapters presented in this volume (see section openings).

Natural resource ecosystems have been observed for some time in research and management studies, but only a few components have been measured or considered in most instances. Several of the chapters in this volume, particularly in Section I, include brief reviews of the development of the ecosystem concept and its adaptation in natural resource management fields. Examples of the concept in research on natural resource phenomena are considered in Section II. Evaluation of ecosystem applications and implications in several natural resource management fields is considered in Section III. The implications of even more inten-



sive resource use in the future and of the implementation of ecosystem concepts on training tomorrow's resource managers and scientists are considered in Section IV.

This volume is based on a symposium held at the annual meeting of the American Society of Range Management in Albuquerque, New Mexico on February 12–15, 1968. The papers, of course, are not restricted to one natural resource field. They cover range, forest, watershed, fishery, and wildlife resource science and management. Collectively, a large number of scientists, educators, and technicians are employed in these professions. For example, approximate membership in three important resource-oriented societies in North America is 4300 in the American Society of Range Management, 16,000 in the Society of American Foresters, and 6100 in The Wildlife Society. These scientists and managers have an increasingly important role in developing and utilizing the biosphere for human welfare.

This volume will be timely because of the widespread current interest in ecosystem approaches. This interest is present in research, management, and academic areas. For example, in the evaluation of topics for the annual meeting at which this symposium was presented, the "ecosystem approach" was second in priority among some fifteen topics evaluated by society membership for inclusion in the program. When I was asked to organize the symposium I found the authors shared this interest, especially because of the opportunity to evaluate the ecosystem concept's applicability to both research and management in several natural resource management fields. Perhaps this reflects the fact that in many resource management fields there is a dearth of good textbooks on the conceptual basis of the field. This volume is not written as a textbook, but it should be a useful reference in resource management courses, especially providing a comparative evaluation of the ecosystem concept in several resource management fields. This volume has particular pertinence to research in the International Biological Program whose theme includes understanding biological productivity to enable adequate estimates of the potential yield of new, as well as existing, natural resources. The ecosystem concept is central to the planning, conduct, and analysis of many of these studies.

I am indebted to the authors and the publisher for their assistance in the preparation of this work.

GEORGE M. VAN DYNE

*Fort Collins, Colorado  
September, 1969*

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## SECTION I THE MEANING, ORIGIN, AND IMPORTANCE OF ECOSYSTEM CONCEPTS

The first two chapters define the evolution, development, and application of ecosystem concepts. In Chapter I, S. H. Spurr briefly introduces the concept of natural resource ecosystems. This chapter provides a framework for those that follow. In this introductory chapter, Spurr brings to bear a long background in natural resource fields. Forester, ecologist, resource analyst, and educator, Spurr has had an interesting career. In 1938 he received his bachelor's degree in botany from the University of Florida, and in 1940 he received his master's degree in forestry from Yale. He then worked at the Harvard Forest before continuing his formal education and was awarded a Ph.D. by Yale in 1950. His next position was with the University of Minnesota School of Forestry. He transferred to the University of Michigan in 1952. There he was first professor, then Dean of the School of Natural Resources, and in 1965 he was appointed Dean of the Rackham School of Graduate Studies. Spurr is the author of four books on forestry and was the founder and first editor of the journal, *Forest Science*.

The second chapter, by Jack Major, reviews the historical development of the ecosystem concept. Major's chapter reflects his broad knowledge of the literature and especially his command of some European languages and Russian. Major reads avidly a broad range of literature in several languages on ecological and conservation topics. Major obtained his undergraduate degree in range management at Utah State University in 1942 and then worked for the Intermountain Forest and Range Experiment Station of the Forest Service, USDA, before a period in the Armed Services in World War II. Major completed his Ph.D. in soil science at the University of California at Berkeley in 1953. Subsequently he was employed by the University of California, first as a weed control assistant specialist and later as a lecturer, assistant, and associate professor of botany at the Davis campus of the University of California. His major activities include teaching plant ecology with special interests in synecology, alpine vegetation, and the flora of California.



# Chapter I The Natural Resource Ecosystem

*STEPHEN H. SPURR*

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## **I. MAN'S ROLE**

A natural resource ecosystem is an integrated ecological system, one element of which is a product of direct or indirect use to man. The product may be biological as in the case of forests, ranges, agricultural products, fish, and wildlife; physical as in the case of water, air, and soil; or both. In all cases, the distinguishing facet of a natural resource ecosystem is that man has a direct involvement in the complex set of ecological interactions.

Management is defined as the manipulation of the ecosystem by man. Beneficial management involves manipulation to maximize the returns to man, while exploitation is management that results in the reduction of the productivity of the ecosystem to mankind over a period of time. The ecological principles of natural resource ecosystems are generally applicable regardless of the particular natural commodity. So, too, are the tools of management and the basic rules governing their application. The principles of ecosystem management apply equally to wilderness and to the urban environment, but they are most clearly understood today with regard to the wildland resources of forest, range, wildlife, and the like.

The purpose of this chapter is to introduce and provide a framework for the nine chapters that follow in this volume. Applied ecosystem ecology has a general philosophical validity of its own. Whether general prin-



ciples are deduced or whether they are induced from specific studies in specific subfields, they have a general applicability to all natural resource management fields. Thus, the history of the ecosystem concept has a general relevance and forms the appropriate basis for the following paper. The other chapters in this volume are concerned with the applications and implications of ecosystem concepts in natural resource management. The contributors have chosen to look at their aspects of the problem from various levels of integration. This is as it should be. We need to understand the problem at the level of the entire natural resource field, whether forestry, range management, wildlife management, or watershed management. Within this broad conceptual framework, we need detailed consideration of specific ecosystems, whether bounded by the limits of a small watershed or by other natural delineations. At a still more specific level, we need to concentrate our measurements on finite experimental plots or areas. Within these areas, individual plants and animals become experimental units, and even these will be treated in parts as they contribute to particular cycles within the broader ecosystem.

In the following chapters, emphasis is given to terrestrial natural resources: ranges, forests, wildlife, and watersheds. Examples are given to show how the understanding of ecosystem concepts can aid in developing plans for wiser and even more intensive use of our natural resources as our world population continues to increase at near exponential rates. Not only do we need to derive general concepts applicable to the study and management of our natural resources, but also we must introduce them into our undergraduate and graduate training programs in the natural resource sciences.

## **II. DEVELOPMENTS IN NATURAL RESOURCE SCIENCES**

I shall say no more about the chapters that follow, because to do so would be anticipatory. Rather, I should like to take advantage of my role as first author by developing the reasons which make me think that this volume is particularly topical and that convince me that we are at the threshold of major developments in the field of ecology, especially as applied to natural resource management. My argument will be illustrated by examples from my own field of forest ecology, but I believe that it will hold for ecosystems other than the forest alone.

Classic ecology has long been divided into autecology and synecology, and the difference between the two major approaches to the understanding of biological systems has been marked. Look at any textbook dealing with the subject and see how distinct are the treatments of autecology and