WILDLIFE ECOLOGY

AN ANALYTICAL APPROACH

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FOREWORD

In recent years, environmental problems have created great general concern. Thus, the time has come when a revitalized and more effective approach to the management of natural resources is necessary. This is especially true in light of increased human populations.

In the past, individual abuses of the natural resources have been treated as isolated problems—an approach doomed to failure. Instead, individual abuses can be seen as parts of a larger problem: the increasing pressure of an expanding population on dwindling nature resources. That problem often appears overwhelming. In seeing it, many have given up in despair. But a great problem may be broken down; each part can be attacked separately and perhaps solved. Bit by bit the big problem becomes solvable. The importance of each issue, whether it be protein availablility, harvest of females, or disposal of waste pollutants, depends on the particular role of the issue in the overall environmental structure.

Wild animals, and the management of them are a vital part of the environmental "machine," a part that also is made of smaller parts. Age, sex, and time of year affect the physiology of an individual animal. These, together with nutritional factors, genetic history, and features of the physical environment, combine in the complex system that determines the interactions between an animal, other organisms, and the land.

It is the essence of the wildlife manager's job that he understand the system and be able to work with it. He must understand how an organism fits into the ecosystem. He must understand the effects of the organism on its total environment and the effects of the environment on the organism.

In *Wildlife Ecology: an analytical approach,* Professor Moen has analyzed this natural system. He evaluates each component and welds them together into a unified whole. Although most of the examples deal with white-tailed deer, the concepts are applicable to the other wild ruminants and, indeed, to all organisms.

Professor Moen's creative research and dedication have produced a work in which traditional pieces of wildlife management—numbers and conditions of animals, nutritive values of range plants, behavior patterns—are at last presented as parts of a greater whole. This book should be made available to every wildlife professional, whether technician, manager, biologist, conservation officer, administrator or researcher. It is an important publication and the time for it has come.

Douglas L. Gilbert

Colorado State University
Fort Collins, Colorado
September 1972

PREFACE

Rapid advances in analytical capabilities within the last fifteen years have made it possible for the ecologist to do things within a time dimension that were unheard of a few years ago. The capabilities for rapid analyses pose a threat to the discipline of ecology, however, because there can be a tendency to use numbers, large quantities of them, hoping by some magical means of computer analysis to find some relationships emerge.

The reorganization of numbers within a computer program of storage and computation is nothing more than a rapid bookkeeping system. Computers used in such a way do not usually help much in gaining insight into the mechanisms that are operating in the natural world. They tend to promote a false sense of security.

The real benefits of computer analyses emerge if they are used to extend the analyst's capabilities for analyzing the relationship between one factor or force and another factor or force in the ecosystem. It is important to realize that the human mind must always be ahead of the computer, with the electronic system doing rapid computations that are too numerous and time-consuming to do in any other manner. This suggests that the first models built by analytical ecologists are of necessity very simple ones. Let them be no more complex than the model builder can fully comprehend, insuring that he knows not only the capabilities of his analytical model but also its weakness. A progression of such simple models will result in more complex, working models that represent a *known* portion of the ecosystem.

In this book I have aimed at promoting the building of simple but workable models. They do not require large computer centers for their use; small desk-top computing systems are entirely adequate. In fact, many of the models suggested can be done manually, with the principles of model building illustrated just as well. Thus the book should be of interest to ecology classes in many types of educational institutions, from the small college to the major university. I am convinced that, wherever the student is located, the major factor that will determine his progress in ecology is his ability to think, along with the guidance of a professor who stimulates thinking about meaningful ecological relationships.

Aaron N. Moen

April 1973

ACKNOWLEDGMENTS

The completion of a book is not possible without the help of many people. My own efforts have been made possible through the kind direction and guidance given to me by my parents on their farm in western Minnesota. The opportunities for contact with wild animals and native plants in that area stirred within me an interest to pursue an understanding of the relationships between organism and environment.

My academic career in the field of natural resources began under the guidance of Dr. Max Partch at St. Cloud State College. His enthusiasm for teaching in the field impressed me greatly. Dr. William H. Marshall, of the University of Minnesota, gave me opportunities, freedom, and responsibility as I pursued a Ph.D. The most significant academic work that permitted me to delve into the energy relationships of deer at that time was that of Helenette Silver and her colleagues at the New Hampshire Fish and Game Department and the University of New Hampshire. Without her pioneering efforts in the field of energy metabolism of white-tailed deer, my Ph.D. dissertation could not have started me on the challenging research on the energetics of a free-ranging animal.

I wish to thank the many friends I have made in the field of wildlife management, especially the deer biologists in the State of New York who always provide stimulating interaction as we proceed together to understand this most important resource in New York State. My colleagues at Cornell, especially Dr. Peter Van Soest of the Department of Animal Science, have provided many insights into the animal-environment relationships currently under investigation. Dr. Douglas L. Gilbert, formerly at Cornell and now at Colorado State University, has discussed big-game management with me on many occasions. Dr. Donald Ordway and his staff of aerodynamic engineers have been of great help in our thermal analyses at the BioThermal Laboratory.

Dr. Dwight A. Webster, former head of the Department of Natural Resources, and the administrators of the Agricultural Experiment Station at Cornell have all been most helpful as I established a research program at the BioThermal Laboratory. Funds for research at the Laboratory have been contributed through the Pittman-Robertson Federal Aid program, Project W-124-R, and the New York State Department of Environmental Conservation. Additional funds from the Agricultural Experiment Station at Cornell, the Cornell Research Grants Committee, the National Science Foundation, The Loyalhanna Foundation, and the National Rifle Association have helped support the work at the BioThermal Laboratory.

The staff at the Laboratory has contributed significantly to the work that is described in this text. My respect for the abilities and dedication of my students cannot be fully expressed by acknowledgment but will be manifested by their contributions in the future. I must recognize the help and accomplishments of former students, especially Dr. Keith E. Evans and Dr. Deborah S. Stevens. The work of Nadine L. Jacobsen and Charles T. Robbins, both Ph.D. candidates studying the energy relationships of deer, has provided much insight into the complex animal-environment relationships that are the focus of study at the Laboratory. William Armstrong, laboratory technician, has helped in the design and construction of research equipment and in the care of our experimental deer herd. Richard E. Reynolds, foreman at the Ithaca Game Farm, has contributed much to the program with his help in the construction of the deer pens, maintenance of the facilities, and continual attention to our needs. Eleanor Horwitz offered many fine suggestions on ways to improve the manuscript. I appreciate her efforts to convince me to say things in the simplest way possible.

Students in my courses have raised many stimulating questions. I wish that each one of them could participate actively rather than passively in the educational process of research and discovery.

Finally, the help and encouragement of my wife, Sharon, and of Ronald, Thomas, Daniel, and Lindy cannot be fully expressed in words. It has often been impossible to keep up with some of the domestic duties confronting every husband and father because of the urgency of research according to a biological clock and my own intense interest in the subject. As Tom (age 9) said when I suggested I might write another book, "Oh no, not another five years of that!"