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0521811279 - Applied Ecology and Natural Resource Management

Guy R. McPherson and Stephen DeStefano

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Applied Ecology and Natural Resource Management

The science of ecology and the practice of management are critical to our understanding of the Earth's ecosystems and our efforts to conserve them. This book attempts to bridge the gap between ecology and natural resource management and, in particular, focuses on the discipline of plant ecology as a foundation for vegetation and wildlife management. It describes how concepts and approaches used by ecologists to study communities and ecosystems can be applied to their management. Guy R. McPherson and Stephen DeStefano emphasize the importance of thoughtfully designed and carefully conducted scientific studies to both the advancement of ecological knowledge and the application of techniques for the management of plant and animal populations. The book is aimed at natural resource managers, as well as graduate and advanced undergraduate students, who are familiar with fundamental ecological principles and who want to use ecological knowledge as a basis for the management of ecosystems.

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To the managers of natural resources who are dedicated to
lifelong learning; may the future rest in their able hands

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Preface

At the risk of merely adding to the bloated and growing literature available on the disciplines of ecology and management while making little meritorious contribution to either, this book attempts to bridge the gap between these literatures and disciplines. As with most books, there are few data and concepts in this text that have not been recorded previously. However, ecology and management have not always been explicitly linked, although each discipline can benefit from the other.

There are many ways that one could link applied ecology to the management of natural resources. Our approach is to focus on plant ecology, and to use this discipline as a foundation for vegetation management. Plant ecology and vegetation management are, in turn, critically important to animal ecology and wildlife management; in many cases, wildlife managers practice vegetation management more directly than they actually “manage” wildlife populations. This additional step – connecting ecologically based vegetation management to wildlife ecology and management – is also frequently recognized but seldom described explicitly, even though it is widely acknowledged that each enterprise can, and does, benefit from the other. Our approach is to use the wealth of information on plant ecology as a basis for the management of both plant and animal populations and natural communities. This book should be especially useful to wildlife ecologists and managers, as it will give insight into the concepts and approaches that plant ecologists use to examine plant communities.

Traditionally, the term “wildlife” has been synonymous with “game,” and only species that were hunted were considered worthy of study or management. Some still believe that the fields of wildlife ecology and management are concerned primarily with deer, ducks, and grouse; professional wildlife biologists have moved well beyond this narrow approach. A similar bias might describe the interests of plant

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ecologists as being limited to pine plantations and row crops. Wildlife ecologists still study species that have recreational or economic importance, but the field of wildlife ecology has evolved. In this book, we define wildlife as any population of vertebrate or invertebrate animals and our interest is in linking our understanding of plant and animal communities to the management of ecosystems. In fact, most ecological principles – and many management practices – that are applicable to a few well-studied species will also apply to many other, lesser known, species. One message that we hope to convey is that it is the questions posed, and the approaches used to address those questions, which are important, rather than the target organism(s) or species of interest.

Many of the concepts and hypotheses within the data-rich disciplines of plant and animal ecology have not been applied to environmental problem-solving. This inability or unwillingness to apply ecological information is vexing and frustrating to scientists who generate knowledge and to managers who attempt to apply that knowledge. The gap between ecological knowledge and application of that knowledge provides the impetus for this book. Thus, this book is designed to organize and evaluate concepts, hypotheses, and data relevant to the application of ecological principles. It serves as a portal into a vast and growing literature on plant and animal ecology and it provides sufficient references to allow the continued exploration of many ecological topics. Most importantly, it provides a framework for the application of the science of ecology to management of ecosystems. The target audience is students and managers who are familiar with fundamental ecological principles and who want to use ecological knowledge as a basis for the management of ecosystems. We are explicitly targeting both students and managers for several reasons. Progressive managers are committed to lifelong learning and are, therefore, students themselves and, as such, this book represents a convenient starting point for new students and an opportunity to refresh, re-evaluate, and “catch up” for managers who have been out of the classroom for some time. Further, the boundaries between the “student” audience and the “manager” audience have eroded, as indicated by the student body in most academic resource-management departments. As recently as 10 years ago, we used the term “nontraditional” to describe students past their 20s; today, these students comprise a significant proportion of most classrooms, and their ranks include many mid-career professionals.

Chapter 1 establishes the foundation for this book and discusses the integration of ecology and management. We begin the chapter

with a description of ecology as science. This would seem obvious to some readers, but most of the public in the United States still fails to see ecology as a science and the management of plant and animal populations as an endeavor based on science. One of our goals is to illustrate and promote these relationships and connections. The four chapters that follow address specific topics related to the ecology of plant populations and the implications for animal populations. In Chapter 2, we discuss interactive relationships among organisms – the stuff that makes ecology ecology. Chapter 3 is an in-depth discussion of community structure and a review of techniques that ecologists use to describe structure. In Chapter 4, we address vegetation succession, including a history of concepts, methods to study and manipulate vegetation succession, and the critical role of vegetation succession in shaping communities. In Chapter 5, we close the circle by attempting to narrow the gap between science and management, emphasizing the importance of thoughtfully designed and carefully conducted scientific studies to both the advancement of ecological knowledge and the application of techniques for the management of plant and animal populations.

We have tried to make this book succinct, readable, and affordable. While it is our hope that it is all of these things, our real intention is to assist managers and students in their attempts to connect plant ecology with animal populations, theory with application, and science with management, and to act as a springboard to additional reading and an impetus to the establishment of working relationships between scientists and managers. With respect to the academic student audience, this book is intended to be used as a textbook for graduate or upper-level undergraduate courses in applied ecology. Depending on the specific interests of students and instructors, a course undoubtedly will require supplemental readings, some of which may be referenced herein. For example, an advanced course in applied ecology could supplement this text with a discussion of discriminant analysis and thorough discussion of several of the references in Chapter 3.

Although we have made every effort to make the book palatable reading, there is no question that some of the material it contains is conceptually difficult. For example, the review of models in Chapter 3 is intellectually challenging, particularly for readers new to the concepts. However, this information is fundamentally important to progressive, science-based management. Recalcitrant readers who resist new ideas will not want to read, reflect on, and understand this material; this book is not intended for them.



Figure P.1 Sonoran Desert, Organ Pipe Cactus National Monument, Arizona. Photo by Stephen DeStefano.

The field of ecology continues to grow, and the importance of effective, science-based management of natural resources increases with each passing day. The science of ecology and the practice of management are critical to our understanding of the Earth's ecosystems and our efforts to conserve them (Figure P.1).

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Several of our colleagues at the University of Arizona have generously provided moral support and good humor. Bob Steidl (University of Arizona), Jake Weltzin (University of Tennessee), and David Wester (Texas Tech University) supplied ideas, examples, encouragement, and much-needed reviews.

Constructive reviews of parts or all of the manuscript were provided by Cindy Salo, Erika Geiger, Cody Wienk, Heather Schussman, Don Falk, Kristen Widmer, and members of the 1997, 1999, and 2001 versions of the Advanced Applied Plant Ecology class at the University of Arizona. Their efforts greatly improved the manuscript.

Few of the ideas in this book are uniquely ours. We have borrowed them from colleagues, many of whom are mentioned in the preceding paragraphs. We thank them for their insight, and ask their forgiveness for losing track of who had the ideas first. Errors of fact or interpretation remain ours.

Guy McPherson

My wife, Sheila Merrigan, serves as a constant source of inspiration and stability in my life. Neither my career nor this book would have been possible without her.

Many of the ideas in this book can be traced to my mentor and colleague, David Wester. His graduate course at Texas Tech University, Synecology, set a standard by which I gauge my teaching efforts. Wester's course served as the basis for the chapter on community structure. Inspiration and ideas for the chapter on interactions were derived from Paul Keddy's (1989) book, *Competition*. Although we have not met, Keddy has been a role model in my pursuit of scholarship.

This book was derived from notes used to teach a graduate course, Advanced Applied Plant Ecology, at the University of Arizona. I taught the course between 1992 and 2001 to a diverse group of students with majors in natural resource management, ecology, biology, geography, arid land studies, and anthropology. These students have been sufficiently interested in ecology to challenge my knowledge and my teaching style, to the benefit of both. Their interest inspired this text; as such, they share responsibility for its development.

Steve DeStefano

It is not customary to thank one's co-author, but in this case it is appropriate. Guy McPherson provided me with the opportunity to contribute to this book, adding examples and insights of animal biology as they relate to plant ecology. Much of the time and effort that wildlife biologists spend in the field are focused on habitat, and, although vegetation is only one component of habitat, it is an important and often measured variable. My collaboration with Guy has not only allowed me to interject wildlife examples into the book, but has also provided me with the opportunity to learn how plant ecologists think and spend their time. These sorts of collaborations are critical to the advancement of science and its application to resource management, and one of my major hopes for the use of this book is that other wildlife biologists will learn from a premier plant ecologist's perspectives.

I especially thank my friend, colleague, and wife, Kiana Koenen DeStefano. Ki more than anyone encouraged me to realign my priorities, put aside the daily busy work, and "get to work on the book." I also thank her for her insights and the many discussions we have had on wildlife ecology in and out of the field. My life, and the profession of wildlife

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ecology, are better because of her. I also thank my parents for their constant support and encouragement in all aspects of my life, personal and professional.

Many of the examples in this book drew from my experiences as a field biologist. For those opportunities I thank Drs. Donald H. Rusch, E. Charles Meslow, O. Eugene Maughan, Christopher Brand, and Maurice Hornocker. I also thank the many state and federal agency biologists and managers, university faculty members, and graduate students with whom I have had the pleasure to work.