

Preface

The community is ... the hierarchical level where the basic characteristics of life—its diversity, complexity and historical nature—are perhaps most daunting and challenging.

Michel Loreau, 2010: 50

For communities ... the task of choosing which topics to emphasize and which to elide [omit] ... is necessarily quirky.

Robert M. May et al., 2007: 111

*Well those drifter's days are past me now
I've got so much more to think about
Deadlines and commitments
What to leave in, what to leave out*

Bob Seger, *Against the Wind*

"What to leave in, what to leave out"? Much of writing well about any subject comes down to this simple question. (I sometimes think much of life comes down to this simple question.) But, as Robert May notes, the task of choosing which topics to emphasize in community ecology is "necessarily quirky." Our discipline is broad and there is no clear roadmap. The organizational path I have chosen for this book is the one that works best for me when teaching this subject to graduate students. I begin with an exploration of patterns of biodiversity—that is, how does the diversity of life vary across space and time? Documenting and understanding spatial and temporal patterns of biodiversity are key components of community ecology, and recent advances in remote sensing, GIS mapping, and spatial analysis allow ecologists to examine these patterns as never before. Next, with species disappearing from the Earth today at a rate unprecedented since the extinction of the dinosaurs, what are the consequences of species loss to the functioning of communities and ecosystems? This question drives the very active research area of biodiversity and ecosystem functioning discussed in Chapter 2.

With the patterns of biodiversity at local and regional scales firmly in mind and with an appreciation for the potential consequences of species

loss, I next shift gears to focus on what I call the “nitty-gritty” of community ecology: population regulation and species interactions, including predation, competition, mutualism, and facilitation. The goal here is to understand in some detail the mechanics of species interactions by focusing on consumers and resources in modules of a few interacting species. From these simple building blocks we can assemble more complex ecological networks, such as food webs and mutualistic networks, which involves exploring the importance of indirect effects, trophic cascades, top-down and bottom-up regulation, alternative stable states, diversity–stability relationships, and much more. In the section on spatial ecology, I focus on the processes that link populations and communities across space (metapopulations and metacommunities) and on the consequences of these local and regional links for species diversity.

The interplay between local and regional processes is a prominent theme throughout the book. Likewise, the interplay between ecology and evolution—what is termed “eco-evolutionary dynamics” or, more broadly, evolutionary community ecology—is an important new area of research. I explore evolutionary community ecology, along with the impacts of variable environments on species interactions, in the book’s final section on changing environments and changing species. Applied aspects of community ecology (e.g., resource management and harvesting, invasive species, diseases and parasites, and community restoration) are treated throughout the book as natural extensions of basic theoretical and empirical work. The emphasis, however, is on the basic science. Theoretical concepts are developed using simple equations, with an emphasis on the graphical presentation of ideas.

This is a book for graduate students, advanced undergraduates, and researchers seeking a broad coverage of ecological concepts at the community level. As a textbook for advanced courses in ecology, it is not meant to replace reading and discussing the primary literature. Rather, this book is designed to give students a common background in the principles of community ecology at a conceptually advanced level. At Michigan State University, our graduate community ecology course draws students from many departments (zoology, plant biology, fisheries and wildlife, microbiology, computer science, entomology, and more) and students come into the course with vastly different exposures to ecology. I hope this book helps students from varied academic backgrounds fill in the gaps in their ecological understanding, approach a new topic more easily, and find an entry point into the primary literature. I’d be doubly pleased if it can do the same for practicing ecologists.

When teaching community ecology, I try to show students how seemingly differently ideas in ecology have developed over time and are linked together. This is important and hopefully useful to students who are just beginning to sink their teeth deeply into the study of ecology. At least, I believe it is useful. An early reviewer of this book wrote, “It is obvious that Mittelbach has a deep understanding and respect for the literature.” I take this as a great compliment. We do, after all, stand on the shoulders of giants, and it’s important to acknowledge where ideas come from. Moreover, an appreciation for the historical development of ideas and for how concepts

are linked together helps deter us from recycling old ideas under new guises. However, another early reviewer suggested that students today aren't all that interested in the history of ideas and that a modern textbook on community ecology should focus on what's new, particularly on how community ecology can inform and guide conservation biology and the preservation of biodiversity. I appreciate this advice as well. I have worked to include cutting edge ideas and to provide case studies from the most recent literature, along with some of the classics. Hopefully, the balance between old and new contained herein is one that works. I recognize, however, that more could be done to illuminate the links between community ecology and conservation biology. Perhaps someone else will take up this call.

Finally, I want to say a few words about the use of mathematical models and theory in this book. Robert May (2010: viii) wrote that "mathematics is ultimately no more, although no less, than a way of thinking clearly." May also pointed out that one of the most celebrated theories in all of biology, Darwin's theory of evolution by natural selection, is a verbal theory. In most cases, however, the ability to express an idea mathematically makes crystal clear the assumptions and processes that underlie an explanation. I have used mathematical models here as a way to "think more clearly" about ecological processes and the theories put forth to explain them. The mathematical models in this book are simple, heuristic tools that, combined with graphical analyses, can help guide our thinking. Readers with limited mathematical skills should not be anxious when they see equations. I am a mathematical lightweight myself, and if I can follow the models presented here, so can you. On the other hand, readers with a strong background in mathematics and modeling will quickly recognize that I have stuck to the very basics and that much more sophisticated mathematical treatments of these topics abound. I have tried to point the way to these treatments in the references cited.

This book is a labor of love that has stretched out for over five years. I always knew that the ecological literature was vast, but I never truly appreciated its scale until I started this project. OMG! It's humbling to spend weeks reviewing the literature on a topic, only to stumble across a key paper later (and purely by accident). I know that I have missed much. I apologize in advance to those scientists whose excellent work I passed by (or simply missed in my ignorance) in favor of studies that were better known to me. Please don't be shy in telling me what I missed.

The first ecology textbook I purchased as an undergraduate in the early 1970s (at the hardcover price of \$7.00!) was Larry Slobodkin's *Growth and Regulation of Animal Populations*. In his preface to this marvelous little book, Slobodkin wrote, "Every reader will find some material in this book that appears trivially obvious to him. I doubt, however, that all of it will appear obvious to any one person or that any two readers will be in agreement as to which parts are obvious. Bear with me when I repeat, in a naïve-sounding way, things you already know" (Slobodkin 1961: page v). Ditto.

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