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BOOK REVIEWS

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Disease Ecology: Community Structure and Pathogen Dynamics. Edited by Sharon Collinge, and Chris Ray, published by Oxford University Press. xii+ 227 pp. ISBN 10: 0-19-856708-1. US $59.50 (paperback).

Review by Chris O'Brien

Although some may argue that the joining of disease science and ecology was slow in coming in the twentieth century, there is no doubt that in the twenty-first century the field of disease ecology has come into its own, as evidenced by the burgeoning rate at which new information is being generated. Works that emphasize the new integration of disease science and parasitology with ecology include textbooks such as Bush et al. (2001) that highlight ecological aspects of parasitology, and volumes such as Hudson et al. (2002) that present ecological aspects of wildlife disease.

A new book that fits well into this genre is the recent volume *Disease Ecology: Community Structure and Pathogen Dynamics* edited by Sharon Collinge and Chris Ray. In this book the focus is on "community epidemiology," which places the epidemiology of pathogen-host systems into a community ecology perspective. As such, this work represents cutting edge information on how communities both affect, and are affected by, infectious diseases. The volume, which contains 14 chapters, two by the editors in addition to 12 invited contributions, was inspired by an organized symposium on community ecology and epidemiology for the 2003 ESA meeting in Savannah, Georgia. The book is organized into a preface, table of contents, a list of contributors, and an introductory chapter by the editors, followed by 13 chapters dealing with a wide variety of topics regarding the community ecology of disease dynamics. Literature cited is provided at the end of each chapter, as opposed to being combined at the end of the book, and an index concludes the book. Although there are several exceptions, the general progression of the book leads from theoretical topics to general review papers to empirical results from studies of the ecology of specific pathogen-host systems. Many of the chapters in the book address emerging diseases in the United States and elsewhere.

Chapter 1 provides the rationale for the volume and places the book into the landscape of recent literature on the topic of disease ecology. The editors bring attention to the fact that this book is the first one to focus on theoretical and empirical studies of infectious disease with relation to community ecology. Additionally, the first chapter provides a road map to the book, defines some important terms, and points out connections, themes, and chapter features that run throughout the volume. Each chapter contains two boxes: one outlines the techniques employed in the study that might have particular use to others studying (and learning the study of) community aspects of infectious disease; a second box highlights disease transmission as a function of community structure. These boxes are especially useful because they provide a connecting thread throughout the volume. Additionally, the editors note that they asked each contributor to consider three questions while preparing their chapter: 1) "What key concepts from community ecology are best illustrated in your study system?" 2) "How do community interactions appear to contribute significantly to pathogen transmission and disease prevalence in your study system?" and 3) "What sorts of community complexity must be considered to effectively predict disease dynamics?" These three questions, combined with the aforementioned boxes, serve as connecting themes among chapters, an aspect that is often overlooked in an edited volume.

Though most chapters in the book constitute a contribution that is centered on an empirical study of a host-parasite interaction, the meat of this book begins with Chapter 2, which provides what the editors consider a conceptual introduction to the rest of the volume. Here, Holt and Dobson, after recognizing the importance of interacting species at the community level and their relevance to disease epidemiology, develop some simple models that can be used to investigate microparasite competition and coexistence. They begin by using two parasites in one host, and then extend the model to two parasites and

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two hosts. In this chapter, the authors provide rich food for thought regarding the possibilities of theoretical models in exploring how communities of parasites and hosts interact. Many of the later chapters of the book may hold differential interest to the reader depending upon her/his specific interests (e.g., zoonoses, human disease, conservation, invasive species, etc.), but the second chapter should be of interest to most readers because it contains general concepts that could be applied to many different situations in the study of community ecology and infectious disease. Their application of "zero-growth isoclines" to community epidemiology is explored at length and holds much promise for future studies in the field.

Chapters 3 and 4 address topics regarding diseases carried by ticks. Lyme disease, the topic of Chapter 3, is discussed by Ostfeld and colleagues, who argue that though an understanding of the role of individual hosts in the epidemiology of Lyme disease is important, a much clearer understanding of this disease's dynamics is revealed when a community approach is adopted. To support this argument, the authors review work that demonstrates how prevalence of the pathogen that causes Lyme disease in humans (*Borrelia burgdorferi*) generally decreases in nymphal ticks with host species richness. However, because hosts have varying competence as reservoirs for *B. burgdorferi*, they differentially affect prevalence in the tick vector, suggesting that as species are lost in habitats, the epidemiology of this disease will change. Furthermore, this suggests that understanding the order in which species are lost is just as important as which species are lost when attempting to understand anthropogenic effects on the epidemiology of this important zoonotic disease. These details and more are laid out in exceeding clarity in this chapter.

While Chapter 3 deals with host community structure and its effects on disease epidemiology, Chapter 4 takes a different look at the same vector by investigating "how the identity and/or number of endosymbiont species affect pathogen prevalence in tick microbial communities." Specifically, Clay et al. ponder the hypothesis that the presence of vertically transmitted symbiont microbes in ticks can correspond to a reduction in the prevalence of horizontally transferred pathogens. The authors provide a preview of work in progress that suggests, at least theoretically, that such a phenomenon is possible. This isn't a data-rich contribution, but this chapter will probably open the eyes of many that have never considered the possible breadth of communities that could exist inside a single vector, the vast possibilities for interaction this very fine scale permits, or the implications of these interactions for the transmission of important human zoonoses.

While most of this volume is dedicated to reports on community epidemiology in animal systems, in Chapter 5 Mitchell and Power provide an interesting and engaging review of current work being conducted on the disease dynamics in plant communities. Furthermore, they make their chapter of more interest to the zoologist by including examples of how pathogens and herbivores can interact in ways that can cascade up the food chain "at scales from the leaf to the ecosystem," underscoring the importance of understanding plant-herbivore-pathogen dynamics in order to understand ecosystem functioning as a whole. This chapter should be required reading for any animal biologist who is unfamiliar with disease dynamics in plants and their potential effects on animals.

Chapter 6 is the first chapter in the volume that reports new data. Here, Unnasch et al. report on current work regarding the transmission ecology of arboviruses, specifically the epidemiology of eastern equine encephalomyelitis (EEE) and West Nile encephalomyelitis (WNV). After discussing some simple mathematical models of vectorial capacity in mosquitoes, the authors report findings from a study that integrates ornithology, entomology, and molecular biology in order to study the dynamics of transmission of EEE in Alabama. Their findings indicate that the host preference of infected mosquitoes and their vectorial capacity may play an important role in fostering the development of enzootic cycles of EEE in avian hosts. There is also a brief review of host-feeding preferences in mosquitoes and transmission of WNV.

Chapter 7 focuses on malaria and on how freshwater community interactions can affect mosquito population dynamics. Rejmànkovà et al., using correlative and experimental studies, show that land-use change, resulting in phosphorous input into phosphorous-limited wetlands, can change the vegetation dynamics within those wetlands. Specifically, they found that nutrient addition led to an increase in cattail abundance, which in turn, due to habitat selection by female mosquitoes, caused a change in the dominant mosquito species. In this case, the mosquito that became dominant had a higher vectorial capacity, thereby causing the potential for increased transmission to human hosts. Thus, this chapter provides a potential example of how land-use changes could increase the potential for

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malaria prevalence, due to changes in plant community structure affecting the mosquito vector community.

The community ecology of a microbe that can act as both a heterotrophic organism and as a pathogen that causes the human disease cholera is the subject of Chapter 8. Here, Cottingham and Butzler consider interactions between different *Vibrio cholerae* strains as well as between *V. cholerae* and other aquatic organisms such as phytoplankton, zooplankton, and other heterotrophic bacteria. Their treatment, a general review of the community ecology of this pathogen, serves as a source of "established information, informed hypotheses and speculation." The authors argue that an understanding of the ecology of *V. cholerae* in its aquatic habitat is essential to understand the epidemiology of this disease.

Chapter 9 takes a look at food webs from the parasite side of things. Lafferty et al. take on the task of building a food web for their relatively well-known study system, Carpinteria salt marsh, near Santa Barbara, California, USA. Then, to illustrate the ecological importance of parasites, they add known parasites to the food web. Their results show that adding a parasite-host subweb disproportionately added to connectivity within the food web and increased linkages within that web, demonstrating the importance of considering parasite-host interactions when considering food webs of ecological systems.

Many chapters in this book, in their treatment of ecological epidemiology, consider how anthropogenic alterations can alter disease dynamics. This subject is the explicit topic of the next two chapters, which address macroparasite disease dynamics along gradients of human disturbance. In Chapter 10, Mary Poteet reports findings from a study that investigates how the intensity of logging disturbance affects the dynamics of three-host trematodes. Her findings reveal the complexities that can emerge between parasites with complex life cycles and their hosts. In this case, though host densities responded to disturbance in certain predictable ways, these responses were not mirrored by the parasites, suggesting that as disease prevalence declined with host density, there were accompanying changes in parasite transmission dynamics.

In Chapter 11, a treatment of urbanization and disease in amphibians, Skelly et al. begin with a literature review that reveals no consistent association between urbanization and macroparasite infection; they summarize published studies that show a range of effects, from positive to neutral to negative. They then report findings from their own study of patterns of trematode infections in amphibian hosts along an urban gradient in Connecticut, which demonstrated that there was no difference in the prevalence of two trematode taxa in two host species along this urban gradient. However, their findings did suggest an effect of urbanization: while amphibians from undeveloped wetlands had the same prevalence of disease as those from urbanized wetlands, infections were of a lower intensity in the undeveloped wetlands, suggesting that disease emergence could result from heavy levels of anthropogenic activity.

Chapter 12 returns to a treatment of a viral pathogen. In this review, Real and Childs discuss the spatial-temporal dynamics of rabies in ecological communities. Although their review does not discuss the effects of community on rabies *per se*, the review does lead to research questions that do involve community ecology: 1) Does rabies affect the community of nonhuman vertebrate hosts? and 2) Do community changes in zoonotic hosts affect the epidemiology of rabies in human populations? Once again, we see that a full understanding of a disease of human importance can only be achieved with an understanding of how community ecology affects and is affected by epidemiology.

A viral disease is also the subject of Chapter 13, which deals with the emergence of Nipah and Hendra viruses in Malaysia, India, Bangladesh, and northeastern Australia. In a review of published and unpublished studies, this chapter is the synthesis of a large group of authors that bring together perspectives from computer modeling to field studies and laboratory experimentation, all yielding insights into the potential causes of the emergence of these diseases. The authors conclude that, as is often the case with new diseases of man, emergence of these viral diseases appears to be the result of human-induced changes to the ecological communities, which allows the disease to incubate and transfer to human hosts.

Finally, in the concluding chapter of the volume, the editors review their own work on another emerging disease, the bacterium *Yersinia pestis*, which causes plague in prairie dogs and humans. In an analysis of the relative importance of colony characteristics that predict epizootics of plague, Ray and Collinge report that surrounding water decreases this probability, as does isolation from other colonies. Furthermore, at one of their study sites located along an urban gradient, they found evidence that urbanization acts to decrease the probability of an epizootic plague event. The authors also provide a nice discus-

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sion of the zero-growth isocline analysis introduced in Chapter 2 and apply it to their study system.

Thus concludes this volume on disease epidemiology. Overall, I found the book a pleasure to read from cover to cover, especially due to the layout that created similarities between chapters, a fact that is often neglected in edited volumes. Furthermore, most authors did an excellent job of providing background information to their study system, which increased the accessibility of the subject matter considerably.

Finally, as is customary, I will provide the obligatory criticism. While the layout was excellent, the chapters might have been arranged topically, or by pathogen phylogenetics, thus increasing the flow of the book; as it is arranged there is little apparent order, especially later in the book. An enlarged glossary might increase accessibility to the student and other readers who are unfamiliar with basic ecological and disease-oriented terms. Also, a synthesis chapter either summarizing themes in the book or pointing the way for future directions in the field might have been enlightening. And finally, a combined literature cited at the terminus of the volume would have been preferred, at least by this reviewer. Overall, these criticisms are very minor and shouldn't detract at all from interest in the book—a volume that I heartily recommend.

I reviewed a hard-copy version of the book, and was a little bothered when the spine began splitting before I finished Chapter 1. By the time I had finished the book, paper clips were holding the book together! According to the Oxford University Press USA website, the hard-bound version is no longer available; at a cost of $124.50, this shouldn't come as a loss to many readers. A more affordable printing (in paperback) is now available that is priced at $59.50.

This book will likely become required reading for those actively engaged in the study of community epidemiology, and the volume should be of great interest to others as well. For example, ecologists interested in entering the field of disease studies will find much of interest, as would disease scientists that wish to include more ecology in their work. This book might also fruitfully form the basis of a graduate-level seminar on disease ecology, and selected readings in a community ecology course would prove enlightening for both graduates and advanced undergraduates. Finally, the volume could make compelling reading for any academic discussion group interested in the wildlife disease ideas contained within.

LITERATURE CITED

Bush, A. O., J. C. Fernández, G. W. Esch, and J. R. Seed. 2001. Parasitism: The diversity and ecology of animal parasites. Cambridge University Press, Cambridge, UK, 566 pp.

Hudson, P. J., A. Rissoli, B. T. Grenfell, H. Heesterbeek, and A. P. Dobson. 2002. The ecology of wildlife diseases. Oxford University Press, Oxford, UK, 197 pp.

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