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ECOLOGY OF PARASITE-HOST DYNAMICS: PRINCIPLES, THEORY, AND ANALYSIS

Hudson, Peter J., Annapaola Rizzoli, Bryan T. Grenfell, Hans Heesterbeek, and Andy P. Dobson, editors. 2002. **The ecology of wildlife diseases**. Oxford University Press, New York. xii + 197 p. \$85.00 (cloth), ISBN 0-19-850620-1; \$40.00 (paper), ISBN 0-19-850619-8.

Many readers of this outstanding volume will be struck by the introductory claim that “(t)he majority of living organisms are parasitic in one form or another, be they a virus invading a sea coral, a tapeworm within the guts of your dog, a cuckoo chick in a reed warbler’s nest or a lion stealing a hyaena’s kill on the African plain.” Why then has research on parasite ecology been so slow to develop, only beginning to burgeon within the past few decades? As the editors suggest, classical parasitology has been focused largely on the description of organisms and characterization of their life cycles. Only recently have efforts shifted toward understand-

ing quantitative and theoretical population dynamics of host-parasite interactions. Indeed, disease ecology, including the environmental determinants of parasite-host distribution and their co-evolution, has become an exciting new field that is attracting scientists from various disciplines. This volume reflects much of that excitement, and represents an important contribution to the entire broad field of ecology.

Although a total of 51 co-authors have contributed to the nine chapters, material is presented in a uniform style that is quite user-friendly. This book grew out of a conference held in Italy under the auspices of *Centro di Ecologia Alpina*. Consistent with both those who attended and the institutions where much of this important research is taking place, virtually all authors are Europeans. The text is attractively laid out, with appropriate use of boxes, and ample figures and tables that are clearly linked to the text. Chapters are organized in a logical manner, beginning with fundamental principles that are later used to expand on basics or particular

domains of research. Each chapter begins with a discussion of the conceptual issues, then illustrates these with clearly presented theory that includes basic mathematical formulations. Next, carefully chosen case studies of field and modeling results are described that complement the background and theory. Chapters end with a synthesis that nicely summarizes the major points. This logical and consistent format makes for easy reading and better understanding. Theory is seamlessly linked to experimental results. It is refreshing to see how the editors have gone to lengths to make this volume so enjoyable to read.

Chapter 1 introduces the history and current status of wild-life disease research, then outlines the material covered and how to approach it. The next few sections address the patterns of parasite infection by considering variation among individual hosts (Chapter 2), effects on host population dynamics (Chapter 3), and impacts on host community ecology and biodiversity (Chapter 4). These chapters are well presented, cover a variety of salient topics, and set the stage for subsequent discussion. Fascinating processes are explored, such as how parasites regulate host populations, compete with each other, influence host-host competition, and affect community structure and stability. The construct of the “basic reproductive number” (R_0) is introduced, and its role in analyses of host-parasite population dynamics is simply and clearly explained. We learn of important differences between “macroparasites” and “microparasites,” and how R_0 is used to measure infection by both. While macroparasites (principally helminths) typically are long lived and reproduce by transmission from one host to the next, microparasites (viruses, bacteria, protozoa) generally have short generation times and multiply within their host. The implications for host-parasite population ecology are discussed.

In Chapter 5, focus shifts primarily to microparasites, with illustration of how transmission dynamics are influenced by host immunity. If they survive infection, hosts usually produce an immune response to microparasite infection, raising the interesting issue of how these parasites persist. The importance of the spatial pattern of host populations is addressed, as this plays a critical role in parasite transmission, especially for microparasites. Chapter 6 is devoted to the problem of host patchiness and how parasite transfer is influenced by these spatial patterns. In one sense, each host represents a patch or island for its parasites. But hosts themselves can be spatially clustered such that local transmission dynamics behave differently in different sub-populations. In another focused section that represents a special group of parasites, Chapter 7 introduces how certain blood-feeding arthropods add to the complexity of parasite-host interactions by serving as transfer “vectors.” Arthropods are a necessary part of the life cycle of these parasites, raising interesting

issues for estimating transmission parameters, R_0 , and transmission patterns. Although exclusively considering vector ticks, this chapter contains useful principles for other vector-borne diseases. Many of the concepts of previous chapters are developed in a way that clearly demonstrates how parasites that are vector-borne have evolved special strategies for persistence.

The last two chapters discuss the role of pathogens in biological conservation (Chapter 8) and future challenges facing researchers in the field (Chapter 9). These are particularly interesting in that they suggest applications of knowledge about the role of pathogens in biodiversity and wildlife management, and the vast terrain of unanswered questions that will ignite new investigations and further implementation.

Implied in many of the issues raised in this outstanding volume are questions about the broader agenda of wildlife disease ecology. Having developed along with studies in human disease epidemiology, this emerging field has added other important factors that are less relevant to or easily studied in human infections. Unfortunately, there is little consideration of wildlife infections that may incidentally cause diseases in people (zoonoses), except in Chapter 7. Indeed, the definition of disease in animals, and how it is distinguished from infection, seems to vary among chapters. In humans, not all infections produce symptoms of disease. Among wildlife, however, “disease” is usually inferred from population-level differences in abundance, reproduction, or behavior. Nevertheless, there are useful constructs of dynamical properties that both share.

This book should be an excellent resource for upper-level undergraduate courses in biology, graduate students in various disciplines, professional ecologists who want to better understand wildlife disease dynamics, and any health professional who is curious about epidemiological processes that influence population-level processes. The editors are to be commended for their efforts to bring together so many fundamental, diverse concepts and findings in the transmission ecology of wildlife parasitic infections. Indeed, they have produced an easy-to-understand, comprehensive compilation that will serve as a text, a reference, and a source of ideas for people from many disciplines. With this volume, the interdisciplinary of wildlife disease ecology has been recharacterized. Highly recommended.

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