BOOK REVIEW

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Lyme Disease: The Ecology of a Complex System. By Richard S. Ostfeld, Oxford University Press, New York, New York. 2010. 232 pp. ISBN 978-0-19-538812-1. $39.95 Hardback.

Review by Maria Diuk-Wasser

Richard Ostfeld's book on Lyme disease ecology "embraces complexity" and presents a strong argument in defense of applying ecological principles to the understanding and potential control of complex diseases like Lyme disease. In contrast with the reductionist paradigm of biomedicine, Ostfeld proposes "a dialogue between homing in (reductionist) and zooming out (holism) and integrating between them along the way." This well-written book, targeting both ecology and health science students and a nonscientific audience, provides a very thoughtful and thorough review and analysis of some of the key issues in the ecology of Lyme disease and other vectorborne zoonoses. Using Lyme disease as a model, Ostfeld emphasizes the need for an integrative approach to understanding the factors that drive the emergence and re-emergence of pathogens, in contrast with approaches that focus on a single species or even specific gene in attempts to find a magic bullet intervention.

Ostfeld structures the book to reflect the evolution in researchers' and the public's knowledge and perceptions of Lyme disease eco-epidemiology. In the first chapter, he describes the controversy surrounding Lyme disease symptoms and treatment. While the majority of researchers and clinicians consider Lyme disease to be relatively difficult to contract and easy to cure in most cases, groups of patient advocates and some practicing physicians think that Lyme disease is vastly more common and severe than "the establishment" claims. Ostfeld proposes that limitations in the quality of diagnoses may be a cause for this "controversy," and that a better understanding of the ecology of *Borrelia burgdorferi*, the causative agent of Lyme disease, could lead us to a better path for prevention and control.

After a short Chapter 2 describing the discovery of the pathogen, vector, and disease, Ostfeld goes on to describe what he later defines as the "dogma" in Lyme disease ecology—that deer and white-footed mice are key hosts for the adult and immature stages of the ticks, respectively (Chapters 3 and 4), and that climate is an important factor driving the distribution of Lyme disease (Chapter 5). In Chapter 6, he presents the main thesis of the book, that our current failure to control Lyme disease is based on lingering ideas from the early years that only one or a few key host species exist for the bacterium. Chapters 7, 8, and 9 present evidence supporting his thesis, mostly from his own research, and develop Ostfeld's signature ideas on the role of food webs and biodiversity in the transmission of *B. burgdorferi* and in human health. In Chapter 10, he illustrates how little we have used our understanding of complex interactions in the design of control methods. Chapter 11 presents his proposed agenda for focusing future research to have a more significant impact on the health burden of vectorborne and zoonotic diseases.

While most of the book reviews previous work, Ostfeld presents some new and

exciting ideas in Chapter 10. He presents his "host immunity" hypothesis on why species of hosts that respond favorably to human-caused disturbances by "living fast and dying young" are often more competent hosts for pathogens. He proposes that, "just as these fast-paced, resilient species tend to trade off their ability to stand their ground and fight competitors and predators, so too have they sacrificed their ability to resist pathogens, in order to accelerate reproduction and dispersal." As an alternative, the "pathogen virulence" hypothesis postulates that the pathogen has evolved to be able to proliferate optimally in those hosts that it encounters more frequently, (i.e., the weedy species). Although not mutually exclusive, an understanding of the relative roles of these mechanisms in nature can lead to different predictions regarding the potential role of different hosts for new and emerging pathogens, a fascinating area of research that will hopefully be more fully developed in the future.

Throughout the book, Ostfeld makes clear efforts to provide a balanced presentation of differing viewpoints and bodies of research. However, research from his group is often presented in a more positive light than that of others. For example, he dismisses most large-scale studies examining the influence of climate on tickborne diseases as "fishing expeditions" and "correlational studies," in contrast with the long-term studies his group has conducted, mostly in Dutchess County. While the value of these long-term studies is not doubted, research conducted at a single site could lack generalizability. Interpretation of results presented in graphs in support of his propositions is also sometimes biased, with lines fit to points "providing an unequivocal yes" (Fig. 38) or fitting "extraordinarily well" (Fig. 58), even if a close look at these figures may not necessarily lead to those conclusions.

In sum, this book is an excellent reference and very insightful review of the history and eco-epidemiology of Lyme disease. Focused more on the ecology than the epidemiology of Lyme disease and other emerging zoonoses, it will surely provide useful background and new ideas to those interested in wildlife, vector-borne, and zoonotic diseases, providing a much more nuanced appreciation of their complex natural history and interactions with humans.

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