

Essentials of Disease in Wild Animals

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BOOK REVIEWS

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Essentials of Disease in Wild Animals. By Gary A. Wobeser, Blackwell Publishing, 2121 State Avenue, Ames, Iowa 50014, USA. 2006. 243 pp. ISBN-10: 0-8138-0589-9. US\$69.99 (hardback).

Review by Donald J.

For many years those of us who teach introductory undergraduate or graduate courses in wildlife diseases have yearned for a text that our students could use as a supplement to our lectures. Finally there is one, and it is excellent. Gary Wobeser at the University of Saskatchewan, Saskatoon, Canada, has produced an outstanding book to be used in such a course. He states in the preface that he initiated the book because he "...perceived that many of those who are called upon to work with disease in wild animals lack experience or training in the general features of disease as they relate to wild animals." This book goes a long way in solving that problem. The author also states in the preface that this book evolved from a graduate course he taught periodically over a 30-yr period in which he initially focused "...on individual causative agents and their effect on the individual animal, in terms of the clinical disease and pathology (sic) that they produced." He later modified his emphasis to discuss the general aspects of wildlife health, including how and why diseases occur and their effects on populations rather than on individual animals. This book is largely concerned with the latter emphasis.

In a number of places in the text the author appropriately quotes from the writings of Aldo Leopold (1933) who wrote in his classic book on "Game Management" about the importance of wildlife diseases and stated a number of viewpoints that are still relevant today. One of Leopold's statements that seems especially applicable is that "The role of disease in wildlife conservation has probably been radically underestimated." When I first became interested in wildlife diseases back in the late 1950s I noticed that many of the well-respected ecologists such as Charles Elton

(1927) and David Lack (1954) did not hold the view that diseases have important effects on wildlife populations, but rather felt that environmental factors and food were of prime significance. This idea was perpetuated for quite some time and only in the last 20 years or so, have ecologists reexamined this issue with the fresh outlook that diseases might need to be more carefully studied in relation to their effects on population dynamics. Wobeser's well-written book helps to further dispel the notion that wildlife diseases are of little overall importance.

The book is organized into a preface, 14 chapters, an appendix giving the scientific names of the species of wildlife cited in the text, a nine-page glossary of technical terms, and a 27-page bibliography. In each chapter many examples drawn from the author's own experience and from the published literature are used to illustrate the points being made and some of these are supplemented with photographs and/or drawings. Each chapter ends with a summary in which the main points that are stressed in the chapter are given. This section will no doubt be welcomed by students just beginning the study of diseases and their role in wildlife populations.

There are several themes that are woven nicely throughout the book. These include: 1) the ecological complexity of disease in wild animals and our lack of knowledge of the various factors involved in wildlife diseases in contrast to the larger body of information on diseases of humans and domestic animals; 2) the negative role of mankind in the cause and perpetuation of disease outbreaks; 3) the concept of energy cost involved in disease and the tradeoffs with other physiological activities; and 4) the lack of appreciation of the effects of subclinical conditions that cause a drain on the well-being of wildlife in contrast to diseases that cause "piles of dead bodies."

Chapter 1 (Introduction). In this chapter the author points out that the study of wildlife diseases is a relatively new discipline and that during the past 20 years there has been a significant growth in interest in this aspect of wildlife biology. He attributes this in large part to a growing appreciation of emerging

infectious diseases that involve both humans and wildlife. Of secondary importance is increased attention by wildlife managers and conservation biologists to the study of the interactions of diseases of domestic and wild animals and also of the impact of disease on wildlife. He also stresses that diseases of wildlife will continue to become more important because of many ongoing changes such as growing populations of humans and geographic and demographic changes that increase contact between domestic animals, humans, and wildlife. He completes this chapter with a discussion of what he calls the "interface area" in which he stresses the idea that wildlife diseases are complex, often involving numerous interacting factors such as infectious and noninfectious disease agents, and thereby require a multidisciplinary approach.

Chapter 2 (What is disease?). Wobeser gives a broad definition of disease, one that he initially proposed in the first edition of his book on waterfowl diseases (Wobeser, 1981). He states that disease is "any impairment that interferes with or modifies the performance of normal functions, including responses to environmental factors such as nutrition, toxicants, and climate; infectious agents; inherent or congenital defects; or combinations of these factors." He goes on to elaborate on this definition and points out that an animal's health/disease is actually somewhere on a continuum between "absolute health" on one end through "relative health" and "disease" to "death" on the other end. Other sections in this chapter contain interesting discussions on injury and reaction to injury, disease nomenclature, and the cost of disease from a balance of energy standpoint. The chapter is completed with useful presentations on the concept of disease as a three-part model (consisting of the disease agent, the host, and the environment) and the relationships between exposure and resistance.

Chapter 3 (What Causes Disease?). The author gives a nice overview of the various causes of disease in wildlife, including examples of each. He divides these into infectious (causes due to living agents such as viruses, bacteria, fungi, algae, protozoans, helminths, and arthropods), noninfectious (genetic disorders, physical agents, metabolic alterations, degenerative changes, nutritional deficiencies, and chemicals), and noninfectious transmissible diseases which include the prions that cause transmissible spongiform encephalopathies such as chronic wasting disease. He adds a fourth category for unknown etiologic agents that cause diseases such as neoplasia. This chapter also contains some helpful definitions

and clarifications of terms such as etiology, signs vs. symptoms, infection vs. disease, infectious vs. contagious, and intensity. These will be extremely useful to the beginning student as well as experienced disease workers and hopefully will decrease the erroneous use of these terms that is so common today even in the published literature.

Chapter 4 (How Disease is Detected, Described, and Measured). The author lists four basic categories of disease surveillance: searching for sick or dead animals, searching for the etiologic agent, searching for a physiologic response to the etiologic agent (e.g., antibodies), and searching for evidence of the disease or the etiologic agent in other hosts. He provides a useful discussion on the validity of tests used to detect evidence of a disease or disease agent in relation to sensitivity and specificity and gives examples. The chapter ends with a section on measures of frequency and patterns of disease in populations, including clear definitions of such terms as incidence, prevalence, mortality rate, case fatality rate, enzootic (endemic), and epizootic (epidemic).

Chapter 5 (Damage, Pathogenicity, and Virulence). Wobeser discusses the concept of virulence in this chapter and defines it as "...a measure of the ability of an agent to cause harm to an animal." He considers a number of current explanations of the importance and reasons for the variation and changes in virulence. His treatise on the variations in response of different species of host to the same disease agent is especially well done.

Chapter 6 (Defense, Resistance, and Repair). The main topic of this chapter is resistance, which is defined as "...all of the defense mechanisms used to withstand diseases." These include behavioral avoidance of infectious disease agents on the part of the host, physical barriers to disease agents, innate or natural responses to disease agents, and acquired immune responses including humoral and cell-mediated immunity. At the end of the chapter there is a brief, but interesting, discussion of interactions that influence the defense or immune system of an animal such as restricted energy intake; concurrent infections with more than one agent; stress factors such as crowding and cold temperatures; environmental contaminants; and host gender.

Chapter 7 (Environmental Interactions). The main topics of this chapter are stress, abiotic factors (topography, climate and weather, water, bedrock, and soil), and biotic factors (vegetation and animals of the same and different species) that influence the host-

disease agent relationship. Included are a number of useful tables which contain pertinent features and examples of the effects of these factors on wildlife. There is also a flow chart, using avian botulism as an example that illustrates the various environmental influences that can occur in a "series of steps" and in turn can affect the probability of disease being the end result. The author points out that human populations and resultant anthropogenic environmental changes "...have a greater overall effect on disease in wild animals than does any other single factor or species." He adds that these changes happen at a greater rate than natural environmental disturbances and that wildlife populations might not be capable of adjusting appropriately to these changes.

Chapter 8 (Transmission and Perpetuation of Infectious Disease). The transfer of infectious disease agents from one animal to another and the maintenance of the infection or disease within a population are discussed in this chapter. Transmission is broken down into three important steps: exit from an infected host, passage through the external environment to a new host, and establishment in the new host. The author classifies transmission into three types: vertical, pseudovertical, and horizontal. The difference between vertical and pseudovertical transmission is not clear. The author states that vertical transmission includes the passage of disease agents through milk from the parent to the offspring, but goes on to define pseudovertical transmission as the passage of agents from parent to young shortly after birth. Horizontal transmission is further broken down into direct and indirect, and wildlife examples from the literature are given. The chapter is concluded with an interesting discussion of the establishment and perpetuation of infectious diseases, including quantitative aspects of the host population such as its social structure and demographic features. The course of a disease outbreak is described and illustrated in the context of an epidemic curve. The persistence of disease agents in populations also is explained in relation to host specificity and other factors.

Chapter 9 (Noninfectious Disease: Nutrients and Toxicants). Nutritional deficiencies might be direct limiting factors for populations of wild animals, but as Wobeser points out, little is known about this aspect of wildlife diseases. He does a good job discussing what is known and cites several recent publications for the reader's further study. He points out that nutritional deficiencies "...occur and that these often relate to recent human-induced habitat changes." The bulk of the chapter is

concerned with toxicology and consists of an overview of the general features of toxicology and more detailed information on heavy metals, pesticides, pharmaceuticals, petroleum and salts, and endocrine-disrupting compounds. The chapter is concluded with a section on assessing the effects of toxicants on wildlife. The point is made that most experimental studies have involved single toxicants, but in nature wildlife are exposed to more than one toxicant at the same time.

Chapter 10 (Effects of Disease on the Individual Animal). In the first section of this chapter the author discusses briefly a number of features common to all types of diseases, including cellular injury and the relationship between injury and energy. The latter discussion is of particular interest. Wobeser states that "We can use energy to understand the effects of individual diseases on an animal and for considering how various factors may interact." He cites several interesting papers in which the trade-offs for energy have been determined between disease and other factors such as growth and reproduction. He concludes that nutrition is of extreme importance and points out that there are weaknesses in the conclusions derived from experimental studies on the effects of diseases on animals that are "given unlimited access to high-quality food and are free of other stressors..." The second part of the chapter is made up of some generalizations about the relationship of disease on direct and indirect mortality and on reproduction in free-ranging wildlife. It is concluded that it is difficult to assess the effects of disease on such animals and that studies designed to measure these effects should be long-term, designed to consider multiple possible interactive factors, investigate experimental manipulation of the suspected disease, include as many variables as possible, and evaluate all components of the immune system.

Chapter 11 (Effects of Disease on Populations of Wild Animals). Many readers might go to this chapter first when they initially open up this book and examine the list of topics in the Table of Contents. This is because the topic is one of considerable interest to many conservationists, wildlife biologists, and others concerned with the survival and welfare of free-ranging wild animals. In the beginning of the chapter the terms population, subpopulation, and metapopulation are defined and examples given. The general features of populations are then discussed in relation to size, spatial distribution, composition (age and gender), and life history traits (*K*- and *r*-selected species). The concepts of limitation, regula-

tion, and compensation of populations are discussed, and finally, the question is posed by the author: "Do diseases really affect populations?" He answers that question by stating "...we can safely assume that disease in its plurality and various forms affects populations." The last sections of the chapter consist of discussions of several examples taken from the literature on noninfectious and infectious diseases that seem to have effects on populations and the concerns about the impact of diseases on small populations that might lead to extinction. The point is made that there are very few empirical data on the regulation of natural populations collected on a long-term basis in such a way as to provide evidence that disease has negative effects on survival and/or reproduction and the relative importance of other interactive factors such as nutrition and predation.

Chapter 12 (Disease Shared with Humans and Domestic Animals). Wobeser begins this chapter by defining *zoonoses* as "...diseases shared by animals and humans or, more specifically, infectious diseases that are transmitted naturally between humans and animals." The remainder of the chapter consists of descriptions of various types of zoonoses and at the end there is a list of practical suggestions for people who work with wildlife so that they can avoid infection by one of these zoonotic diseases.

Chapter 13 (Disease Management). The author points out in this chapter that there are three main reasons why it is important to consider the management of diseases in wildlife, that is, their harmful effects on humans, domestic animals, or species of wild animals themselves. He suggests that the objectives of disease management are to prevent, control, or eradicate a disease and discusses these in terms of the disease agent, the host, and the environment with a number of good examples taken from the literature. He concludes by stating that "Where possible, emphasis should be on disease prevention rather than control or eradication." He goes on to further emphasize that rigid control of translocation of wild animals is the most significant technique for prevention of infectious diseases. His last point is that whatever management techniques are employed, they should be monitored and measured carefully in order to understand their effectiveness.

Chapter 14 (Roundup). This is a conclusion chapter and it is excellent. Here Wobeser reviews several concepts that he has discussed in earlier chapters including the idea that diseases in wildlife are underappreciated,

especially those subclinical conditions that do not result in massive mortality. He also adds more comments about the cost of disease in reference to energy and tradeoffs, the significance of host-specific infectious disease agents (especially on small populations), and man's influence on wildlife diseases.

A close reading of the first edition of any book usually results in the discovery of several shortcomings and errors. This is true for this book in which some problems, mostly minor in nature, were noticed. One of these is that the examples in the book are drawn mainly from the literature on diseases of mammals and birds, with very little on reptiles, amphibians, fish, or invertebrates. This is not a serious problem because the author's main concern was to elucidate principles of wildlife diseases, particularly ecological principles, and this was done successfully with reference to mammalian and avian diseases. This choice of coverage most likely relates to the interests and experiences of the author, and this is valid. Nevertheless, there is a growing interest and resultant body of knowledge on the health of animals other than birds and mammals and those interested in such animals might wish to have them better represented in such an introductory text.

Many of the tables contain references to the source of the information given, whereas others do not. The same is true of the text in places, where specific examples are given and no reference is used to back up the information and provide a source of more data on the example in question. On the positive side, many citations that are given in the text are of great value in leading the reader to more detailed information. In fact, some of these references were a problem for me as I read the book because I looked up a large number of the original papers to read more, and this practice slowed down my review process considerably! But that was my problem, not the author's.

Several words were used incorrectly by the author. For example, on pages 107, 115, and 184 the term *heavy infection* was used. The correct term should be *infections of high intensity* (see Bush et al., 1997). Also, the terms *ecology* (see pp. 25, 166, 176, and 185) and *pathology* (see pp. ix and 134) were not used correctly. Ecology and pathology are terms referring to *the study of* animals and their relationship to their environment, and *the study of* the nature of disease along with the structural and functional changes associated with disease, respectively. The terms refer to disciplines of study. For example, on page 185, the statement that "Environmental manipula-

tion may be the method of choice provided that the *ecology* of the disease is understood...” should read “...provided that the *ecological aspects* of the disease are understood.”

There are errors associated with Fig. 4.4 on page 54 and with the text related to this figure. The symbols for “exposed” and “not exposed” animals apparently are reversed in the figure and the data of this example in the text do not match the data in the figure.

The problems mentioned above do not detract from the overall value of this book; it is an important addition to the literature on wildlife diseases and will not only be used as a text for courses on wildlife diseases, but will be a stimulus to those who are interested in research on and management of wildlife diseases. Students and seasoned investigators interested in the ecology of diseases of wild animals owe a great deal to Gary Wobeser for crafting such a significant and useful book.

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