

**Management of Disease in Wild Mammals.** Edited by Richard J. Delahay, Graham C. Smith, and Michael R. Hutchings, Springer, New York, New York. 2009. 284 pp. ISBN 978-4-431-77133-3. US \$139.00 (hardback).

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*Review by Graham J. Hickling*

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The rabid wolf and the plague rat are the stuff of old legends and children's nightmares. Yet as Planet Earth turns uneasily in this new century, diseases of wild mammals continue to occupy our thoughts. Some of these diseases—rabies, bovine tuberculosis and brucellosis—are old foes, whereas others—Ebola virus and Hanta virus—are newly emerged from our forests and wildlands. Some target us directly, others infect our livestock and companion animals. In return, our own newly globalized pathogens put at risk our endangered wild mammals, even in their remote habitats.

So the question for us now is: what can be done? We have the skills to diagnose and treat a huge array of mammalian diseases in the laboratory and clinic, but not on the tundra or mountain peak. Is it feasible to manage these diseases in the wild, and, if so, how might one proceed? This book sets out to guide us.

*Management of Disease in Wild Mammals* consists of 11 multiauthored chapters, with a total of 57 contributors, many prominent and well-regarded in their fields, representing all continents, except South America and Asia. The book begins with a short introductory chapter by the three editors that defines *disease* and considers the question of when disease in a wildlife population warrants management intervention. Anticipating the argument that disease is a natural component of ecosystems and thus should *not* be managed, the authors provide two responses. First, humans have modified the environment to such an extent that it is questionable whether the ecosystem or the disease event can sensibly be thought of as natural. Second, attempts to manipulate disease in wild animal populations are primarily undertaken for anthropocentric reasons—that is, to benefit us by protecting ourselves and our domestic animals, plus those wild species that we value sufficiently. Equivalent arguments have been made by Wobeser (2007).

The editor's view (p. 8) is that management of wildlife diseases in the recent past has been too often characterized by "reactive, unsustainable and ill-informed" interventions undertaken with little appreciation of the under-

lying ecology of the disease. Their stated aim for this book is to foster a greater capacity to predict and prepare for disease problems involving wildlife and a greater ability to intervene in ways that are effective and sustainable.

Chapters 2 and 3 begin to address these goals by demonstrating that the population structure and ecology of host and pathogen affect contact rates and pathogen transmission and that quantitative assessment of these rates is critical both for designing management actions and for evaluating their subsequent efficacy. Both chapters provide examples centered on direct-transmitted diseases, including bovine tuberculosis in badgers (*Meles meles*) and meerkats (*Suricata suricata*), and classic swine fever in wild boar (*Sus Scrofa*). Chapter 4 focuses on how modeling should be used to investigate wildlife disease. The authors promise (p. 54) to largely avoid "the vast area of purely theoretical modeling" in favor of models that aim to help support practical decision-making—and I thank them for that. The chapter provides an overview of basic modeling approaches, parameterization of models, model limitations, and the use of models to inform policy. The treatment is almost entirely verbal—the solitary equation included is a very short one—and the chapter is lightly referenced, but it succeeds in highlighting the contributions modeling can make to a disease-management program.

The modeling chapter ends with the observation that bioeconomic components are increasingly being incorporated into wildlife disease decision-support models, which provides a lead-in to the Chapter 5 treatment of economic aspects of the problem. Again, the approach taken is to provide a short commentary on the contribution that economics can make, followed by an overview of key concepts, techniques, and data needs for an economic analysis. Discounting, estimation of economic optima, and willingness to pay are traversed briefly. The chapter focuses largely on social cost-benefit analysis but undercuts this by concluding that quantifying the full range of costs and benefits can be problematic for various reasons, including nonmarket aspects of the problem.

The next three chapters review options for the control of disease, covering historic and current techniques for targeting the infectious agent, host, and environment. Chapter 6 emphasizes that direct medication of free-ranging wildlife is rarely an option (although the authors point to several successful examples). The remainder of the chapter focuses on wildlife vaccination, which is gaining increas-

ing attention as an alternative to culling, as vaccination technology and delivery systems advance. The authors note, however, that public enthusiasm for the technique presently outstrips its efficacy and safety under real-world conditions—indeed, several of the positive examples cited are experimental trials using delivery techniques, such as injection, that are impractical for population-level management.

Host population reduction (Chapter 7) has been the most common technique for managing disease in wildlife. Techniques include dispersing, culling (indiscriminant or targeted at infected individuals), and reproductive control. The first of these seems ineffective for mammalian populations. Culling is regularly employed for management of disease in livestock, so it is unsurprising that it is the most common method used to manage disease in wildlife. Culling a free-ranging wildlife population is, however, far more challenging and controversial than is culling of livestock because of the difficulties (and ethical concerns) of removing an adequate proportion of the infected wild population in a sustainable manner. This problem is exacerbated when recreational hunters contribute to the control program because the population reduction needed for disease control may far exceed the reduction that hunters consider acceptable for their future hunting success. The chapter provides a useful review of many approaches to population reduction, including lethal trapping and poisoning (effective if nontarget impacts can be avoided), biological control (no known examples of success), and targeted culls, plus the potential for social structure disruption, compensatory demographic responses, and “knock-on” ecologic consequences for other species. Public opposition to culling is discussed and highlighted as a key motivation for fertility-control techniques, including surgery, chemical and hormonal techniques, and research into immunocontraception. Several successful small-scale trials of the latter are cited; new issues raised by these trials suggest more research is still required.

Environmental management (Chapter 8) is widely used to combat wildlife disease—for example, by rat-proofing buildings and fencing wildlife away from livestock. Conversely, human effects on the environment have often triggered or exacerbated disease outbreaks in wild mammals. Effects of landscape structure (corridors, barriers) on wildlife movement and dispersion are considered, along with manipulation of nutritional resources (food plots, artificial feeding). Large-scale environmental management inevitably requires cooperation

among multiple stakeholders, and the chapter ends with a useful discussion of ways to understand, and perhaps change, attitudes that impede disease management. A particular problem is that the benefits of reduced disease may not easily accrue to the particular stakeholders asked to change their behavior or manipulate their environment.

The final three chapters consider risk assessment and contingency planning for exotic disease introductions (Chapter 9), wildlife disease surveillance and monitoring (Chapter 10), and disease management in endangered mammals (Chapter 11). Because it is impractical to develop contingency plans for all possible disease introductions, planning efforts must prioritize those that present the greatest risk. A generic structure for a contingency plan is presented, and the UK Rabies Contingency Plan is reviewed as an illustrative example. A key consideration in such plans is the adequacy of surveillance for emergence and spread of new disease; Chapter 10 reviews the goals, terminology, and basic quantitative methods associated with investigations, surveillance, monitoring, and surveys (all of which are helpfully defined). The use of sentinel species and the concept of syndromic surveillance are briefly reviewed. This chapter—and indeed the book as a whole—did, however, lack discussion on evaluating management activities, that is, a formal process whereby the data gathered by monitoring is considered in relation to the original management objectives. A recent review of biologic control (Gurr and Wratten 2000) concluded that not only had most programs failed, but the success rate had not been raised by decades of intensive research—I am left wondering what an equivalent analysis of wildlife disease interventions might reveal.

Chapter 11 ends the book by shifting our attention from zoonotic and livestock disease to disease threats to the wildlife species themselves. Beginning with the observation that one quarter of all mammal species are threatened with extinction, the chapter lists 54 mammal species for which disease is considered a threatening process. Disease can be a consequence of environmental effects on a population, so the chapter revisits the book's introductory theme regarding the critical importance of understanding underlying ecologic relationships. Modeling and management of disease threats to the Ethiopian wolf (*Canis simensis*) are presented as one of several case studies that illustrates how management plans for these complex problems can be constructed. Examples of disease interventions target-

ing pathogen, host, and environment are provided, with an additional discussion of disease risks associated with species translocation and reintroduction.

Taken as a whole, this book provides a succinct overview of the key ingredients necessary for an effective disease-management program. Each chapter cites a modest number of well-chosen references, many quite recent, which are compiled in a single reference section at the end of the book. The book will be an appropriate text for a graduate or senior undergraduate wildlife health or applied ecology course and will be a useful resource for mathematical ecology students. Researchers and modelers will need to dive into the cited references for more detail on many points but will appreciate the comprehensive reading list these citations provide. The authors hope the book will be useful for policy-makers, and I think it will be, in explaining the necessary role of each member of the multidisciplinary teams that need to be built to tackle these kinds of problems.

I had only two negative reactions while reading the book. The first was regarding the rather limited consideration of vector-borne diseases (the index contains more than 80 references to rabies and bovine tuberculosis versus less than 10 on ticks, mosquitoes and flies). This contrasts with the inclusion of both a mosquito and a Lyme disease tick among the book's seven cover photos.

My other reaction was prompted by comments concerning disease in the North American context. In the economics chapter there is a statement (p. 82) that "... wildlife species may be valued for sport... reduced wildlife numbers could impact the local economy... visitors would probably spend their money in another area... thus there would be no loss to

the national economy as a whole." This undervalues the billions of dollars that US sportsmen spend on wildlife and misses the point that most management activities and revenue-gathering happen at the state level, so any shift in revenue out of state will have major implications for the sustainability of disease-management plans. Further, in the environmental management chapter, there is a statement (p. 160) that in Michigan "... deer culling was successfully employed to reduce local deer densities below the threshold at which bTB [bovine tuberculosis] could persist..."; I am sure Michigan Department of National Resources' wildlife veterinarians will be delighted (but surprised) to hear this news.

This impressive book concludes by reminding us that although many diseases in wild mammals are familiar (rabies, bovine tuberculosis), new pathogens continue to arise from unexpected sources (devil facial tumor disease in Tasmanian devils [*Sarcophilus harrisi*], Ebola Zaire virus in several species of Central African bats). To predict, prepare for, and detect such diseases remains a daunting challenge, despite the best efforts of the combined authorship of this book.

#### LITERATURE CITED

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