

HAJEK, E. A., GLARE, T. R., AND O'CALLAGHAN, M. O. (EDS.) 2008. Use of Microbes for Control and Eradication of Invasive Arthropods (Progress in Biological Control vol. 6). Springer, Dordrecht, The Netherlands. xvi + 366 pp. Hardback. ISBN 978-1-4020-8559-8. \$189.

This book is part of the 'Progress in Biological Control Series' published by Springer. Each book in the series provides an in-depth review of some fairly narrow aspect of biological control, with the entire series presumably designed to provide a comprehensive overview. As suggested by the title, this book is devoted to invasive arthropods, an important and timely topic. Due to the fact that many of the most important arthropod pests throughout the world are invaders, this book assumes great significance because it documents the progress made in addressing microbial control of some of the world's most significant pests.

Initially I was struck by the odd emphasis of the title: eradication. Most entomologists know that eradication is a difficult task, and generally limited to those few instances where invaders are detected early, before they have opportunity to firmly establish and spread. Further, eradication efforts normally involve multiple applications of chemical insecticide, either as the sole basis of elimination or followed up by another technique such as the release of sterile male insects. So my response to the second line of the book, which states that microbes have been used very successfully for eradicating and controlling a range of invasive arthropods was a rather skeptical "really?" My confidence did not grow as I read further in the opening chapter and found the oft-repeated but largely undocumented statement about the "ever-increasing rate of new invasions." From the data I am able to access for the USA, the number of introductions and impact of the introductions continues to grow, but the actual *rate* of introductions is no higher that it has been in the past. Then I re-read this section and found that the author was comparing the pre-Columbus period to the post-Columbus period in the New World. In this context, the statement is correct, although elsewhere in the book a similar statement also appears, and it is not so clear. In general, the first chapter was devoted to an introduction to the remainder of the book.

The next 2 chapters deal with ecological aspects of pathogens and invasive arthropods. In Chapter 2 the authors discuss the role of indigenous (native) pathogens in providing biological suppression. Unfortunately, native species are described as 'endemic' in Chapter 2 but (more correctly) 'indigenous' in Chapter 3, continuing the long-standing confused use of terminology surrounding invading organisms. The emphasis of Chapter 3 is population processes related to invaders, but particularly the interesting Allee effect (decreasing population growth rates associated with decreasing abundance), and the importance of this in allowing eradication to occur.

The next 2 chapters are devoted to case studies of the application of microbes for eradication of lepidopteran pests in New Zealand and North America. Discussed are white spotted tussock moth and painted apple moth in New Zealand, and European gypsy moth and Asian gypsy moth in North America. I should have anticipated that all the cases of successful microbe-based eradication of invasives would involve *Bacillus thuringiensis* (Bt) and lepidopterans. Because the Bt toxin is insecticide-like in most of its properties and can be applied like an insecticide, it is not surprising that this product was successful in promoting eradication. Further, in the case of painted apple moth the population suppression by Bt was followed up by sterile insect release. Thus, my preconceived notions about eradication were fulfilled but my skepticism was unwarranted, and I gained a new appreciation for the potential of microbes, at least Bt, to achieve eradication. However, it is interesting and appreciated that as the authors provided case studies they reported both the official declarations of establishment and eradication, but qualified these with data on the numbers of insects captured both before and after eradication events. Anyone who follows regulatory entomology knows that sometimes insect detections do not translate into establishment, and therefore the success rates of eradication efforts are potentially inflated. The authors wisely report the data and avoid speculating about cause and effect.

The most important portion of this book is the 'control' studies reported in Chapters 6-15. Each chapter is devoted to a pest species or species assemblage. They are informative discussions of biological suppression efforts, and they range from accounts where the results can only be described as disappointing (e.g., aphids, pests of honey bees), to quite successful (e.g., rhinoceros beetle, pine woodwasp, cassava green mite, mole crickets). The value of these chapters is in the detailed discussion, particularly because most authors describe the process from inception to current status, including the false starts and failures in addition to the successes. This approach gives the reader a good sense of the immense, interdisciplinary effort required to achieve success, and it is clear that in many cases decades of effort are required. Importantly, a common theme is that microbe and nematode strains change in virulence over time, necessitating creative 'fixes.' Anyone contemplating becoming involved in biological suppression efforts using microbes and nematodes (including suppression of indigenous pests) should read all these chapters before proceeding; there are valuable lessons to be learned here.

Chapters 16-17 examine the health and environmental effects of microbes used for insect suppression. As is normally the case, the more recent data continue to show minimal negative effects. The authors point out that the public is skeptical about the reported safety of microbes, however, so continued emphasis on health and environmental monitoring is necessary.

The final section, Chapter 18, is basically a summary of the book, but also succinctly points out some of the issues/challenges confronting use of microbes for biological suppression.

Overall, this book is a very useful contribution to the biological control literature. It is an excellent update to a rapidly changing field, contains

practical information, and helps prepare practitioners for the challenges they will confront. The only shortcoming (and it does not really detract from the book's utility) is that there was not a consistent attempt to put microbe-based suppression into context. How important are microbes versus predators or parasitoids in these case studies? Probably the answer is 'it depends', but it would have been nice to see the opinions of these authorities.

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