Invasion Biology

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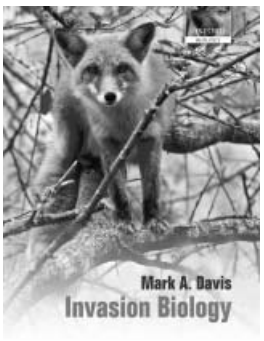
Exponential Growth in Invasion Biology

Invasion Biology. Mark A. Davis. Oxford University Press, 2009. 288 pp., illus. $55.00 (ISBN 9780199218769 paper).

Over the past two decades, the literature in invasion biology has grown in much the same way as the populations of many of the organisms it studies: exponentially. Since humans began moving species around the globe, invasions of ecological communities by nonnative species have accelerated to unprecedented levels. Although most nonnative species are benign or even beneficial (e.g., food plants), the minority of species that become invaders are associated with an array of negative ecological and economic impacts. There is a clear need to understand biological invasions in order to predict which species will invade which regions and why. But despite the exponentially growing literature, invasion biology remains a field characterized by a wealth of anecdotal studies with few general principles.

Invasion Biology, by Mark Davis, is the first single-author volume on the subject since Williamson's book *Biological Invasions* (1996), although several edited volumes have been published in the intervening years. The first two parts of Davis's book comprise an extensive review of the literature on invasion biology, beginning with the invasion process itself and leading into a discussion of the impacts and management of invasions. In the third part of the book, Davis steps back to provide a refreshing reevaluation of the status of invasion biology as a science.



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Davis is well qualified to produce this latest synthesis of invasion biology. He is a plant biologist and professor of biology at Macalester College in Minnesota. He has published extensively on invasion biology; he is perhaps most noted for his hypothesis that fluctuating resource availability is the key factor controlling the susceptibility of an environment to invasion. His knowledge of the literature is particularly welcome in a field that has grown so quickly.

The first two parts of the book are heavy reading but will serve as an essential reference source for ecologists with an interest in invasion biology. The literature review is presented in a rigorous and objective manner. With roughly 1000 references, it is likely that most readers will find something to surprise them. Just one example is the remarkable speed at which evolution has occurred in conjunction with some invasions: In Australia, nonnative cane toads have evolved longer legs that facilitate their further spread; in New England, native mussels have evolved thicker shells that protect against a predatory nonnative crab. As Davis acknowledges, any review of invasion biology will necessarily omit studies of perceived importance to some people. Davis admits to focusing on the literature published after 2000, but I still felt that a short discussion of reaction-diffusion models of invasions, which model the growth and spread of an invading species across a landscape, would have been appropriate (Shigesada and Kawasaki 1997). Reaction-diffusion models, especially those extended to generalized probability density functions (dispersal kernels) that allow for long-distance dispersal (Kot et al. 1996), have shown considerable success at predicting the spread of established invasions—this is particularly welcome in a field characterized by a lack of generalities.

Although Davis saves most of his analysis and discussion for the third part of the book, he does not hesitate to adjudicate briefly on certain issues as they arise in the earlier parts. After reviewing the evidence on the enemy release hypothesis (which postulates that some invaders are successful because they have escaped from their natural enemies), he concludes that the abundance of enemies is of lesser importance than resource availability in determining the success of invasions. After reviewing the evidence on both sides of the diversity-invasibility debate (which addresses the question of whether diverse ecosystems are more resistant to invasion), he concludes that diversity is not a reliable predictor of invasibility. Davis also expresses a preference for nonequilibrium rather than equilibrium theories of ecology. Many of these comments in the earlier parts of the book foreshadow his conclusions in the third part.

The third part of the book stands alone as a reflective and potentially seminal discussion of the state of invasion biology. For biologists who have not followed the invasion biology literature in recent years (or who do not read the first two sections), this short, 33-page section will provide insight into the current state of the field from one of its leading practitioners. Davis comes to conclusions that are largely supported by his preceding literature review but will be nevertheless controversial for some readers: He proposes that invasion biology be subsumed under general community ecology; he criticizes niche-based theories of invasion biology; he argues that the claim that nonnative species are the second-greatest threat to endangered species is a preliminary idea that has prematurely acquired the status of an established fact; he suggests that the native-invader paradigm may be

motivated by xenophobia; and he proposes a dubious acronym as an alternative to the term "invasion biology."

I have several relatively minor criticisms of the book. I was concerned that the emphasis on the invasion pressure model (introduced in chapter 6 and revisited in chapter 8) was unwarranted. Davis uses the model to argue that propagule pressure (*N*) and invasibility (*P*) have approximately equal impacts on the invasion process, and that there is a management sweet spot called the "invasion cliff" at which invasion pressure exhibits a nonlinear relationship with *N* and *P*. However, I found it difficult to believe these claims for two reasons: First, invasibility (*P*), although well defined mathematically, is difficult to measure biologically and cannot be expected to have a linear relationship with management effort; and second, the invasion cliff is an artifact of log-transforming the *N* and *P* scales. On another issue, while I agreed with Davis that much theory in invasion biology has been characterized by "duplication, redundancy, and reinventing the wheel," I did not feel that this justified his subsequent assertion that theory has a limited future role in contributing to management. One could just as easily argue the opposite: The mediocre performance of past theory and the sheer impossibility of managing all invasions across the globe motivates the development of better theory, so that scientists can work with managers and policymakers to allocate resources optimally between different strategies for the prevention, eradication, and mitigation of those invasions that pose the gravest threat to economic and environmental resources. Finally, the abundance of typographical errors that have slipped into this book, mostly in parts one and two, are distracting to the reader and suggest that the editing process was completed hurriedly.

Overall, I recommend *Invasion Biology* as an essential reference for invasion biologists and a useful addition to the library of other ecologists. It is also an excellent starting point for those new to the field. Davis has produced a thorough record of the current state of the subject, and he has charted a roadmap that will guide research for years to come. In calling for invasion biology to be unified with community ecology, Davis has staked out a position that will fuel lively discussions. Although readers may disagree with him on this point or another, Davis's tone is generous and admits such disagreement. It seems unlikely that ecologists will heed the call to unify invasion biology with community ecology, or that the exponential growth in the invasion biology literature will cease any time soon. Thus, Davis's book will not be the last monograph on the subject, but it is nevertheless a valuable contribution to the literature.

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FOCUS ON SNAKE CONSERVATION

Snakes: Ecology and Conservation. Stephen J. Mullin and Richard A. Seigel, eds. Cornell University Press, 2009. 384 pp., illus. $60.00 (ISBN 9780801445651 cloth).

Snakes: Ecology and Conservation represents an intellectual outgrowth of the Snake Ecology Group, which periodically holds informal meetings and fosters the publication of books that aim to synthesize current knowledge and perspectives related to the ecology of snakes. This book follows two others—*Snakes: Ecology and Evolutionary Biology* (1987), and *Snakes: Ecology and Behavior* (1993), and focuses on conservation. It reflects three goals of the editors and collective authors: to summarize current knowledge and concepts of ecology and conservation as related to snakes; to compile primary literature that can guide both new and established researchers; and to identify deficits in our knowledge of these subjects, thereby stimulating new and innovative research in an effort to advance understanding. Because the diversity and abundance of snakes are in decline, as with many other other vertebrate taxa, two other goals are implicit: namely, to enhance awareness of threats to snake populations, and to examine strategies that are available to counteract further population declines or extinctions.

Editors Stephen J. Mullin and Richard A. Seigel are snake ecologists known for promoting communication and synthesis of ideas among herpetologists. Leading snake biologists—including specialists in ecology, behavior, genetics, and evolutionary biology—have contributed 12 chapters to this volume. Collectively, these cover a breadth of topics and include relevant discussions of tools, modeling, and methodologies related to snake ecology and conservation. Many of the topics relate to broader conceptual issues and perspectives, but the presentation here is focused specifically on snakes. Covered also are the challenging problems of how we must address ophiophobia, design conservation programs, and promote the utility of snakes as indicator species for monitoring ecosystems and managing habitats and reserves. The disciplinary themes represented