

from the old, arrogant and unlamented 'technology transfer' approach, through participatory research and actor-oriented or action research and, finally, to research as 'part of a social learning process', in which researchers and the information that they can provide represent just one element of a complex system that determines natural resource users' decisions.

No one is likely to argue against the need for involving end users in all stages of research, or the importance of incorporating social and institutional factors. However, some might take issue with the endpoint of this logical progression, where the main purpose of research and the role of researchers appears to be social facilitation, rather than providing technical data and insights. For example, the authors cite Hagmann *et al.* [1]: 'The intervention of the research team was geared towards strengthening organizations by enhancing accountability, improving leadership and facilitating critical self-awareness.' Although these are worthwhile objectives, they do not seem to represent science or research as most of us understand it. The authors do acknowledge that new technologies, and the discipline-oriented hard science that produces them, are still needed and that, in fact, this is what the resource users themselves seem to want. However, they propose that

the main role of researchers should be to build the stakeholders' capacity to identify the targets of such research and to carry it out themselves.

The case studies discussed illustrate how old-fashioned, narrowly focused, scientist-dominated research has been progressively replaced by more multidisciplinary, participatory and adaptive approaches in three complex socio-ecological settings in which the authors have extensive personal experience: the rangelands of southern Africa, the forests of Borneo and Andean hillside agriculture. Although clearly demonstrating the benefits of this evolution in research approach, the case studies provide a refreshingly frank self-critique, proving the truth of one of the authors' main messages: we are only at the beginning of the road to finding solutions to the complex challenges of NRM in the real world. This book will be of great interest to anyone involved in carrying out, supporting or using research to improve NRM in developing countries.

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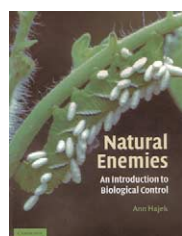
Book Review

Biological control is more than just natural enemies

Natural Enemies: An Introduction to Biological Control edited by Ann E. Hajek, Cambridge University Press, 2004. £80.00/£30.00 hbk/pbk (394 pages) ISBN 0521652952/0521653851

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The past decade has given rise to exciting new developments in the field of community ecology that have profound implications for biological control. The recognition that biological invasions offer unprecedented opportunities to investigate the nature of community assembly has swept invasive species studies to the forefront of popular ecology. Meanwhile, progress in research on facilitation, competition, predation, parasitism, behavior, complexity and diversity has led to greater understandings of the roles these forces play in determining the strength and nature of direct and indirect effects in community ecology. Given that biological control is, fundamentally, deliberate community assembly, applying knowledge of how these forces converge to determine the outcome of community assembly holds great promise for the advancement of biological control. For these reasons, I was excited at the prospect of finding this new information integrated into the latest textbook on biological control.

In the preface to *Natural Enemies*, Hajek states that

her intent was to provide a comprehensive introductory textbook that would introduce students to natural enemies with an overview of biocontrol. Hajek successfully introduces the gamut of natural enemies and different strategies for biological control with effective use of text boxes, pictures and anecdotes. Moreover, her coverage of the history and applications of the subdisciplines of biological control in the context of real-world logistical and economical limitations is commendable. However, as a comprehensive introductory textbook about biological control, *Natural Enemies* fails to move beyond the anecdotes to provide any real means for students to understand fully why, when and how biological control should work. In this regard, *Natural Enemies* not only fails to incorporate new ecological information to advance the field of biological control as a science of community assembly, but it also embodies the many problems that have haunted biological control over the years.

Hajek's theoretical framework for biological control, similar to that of the field in general, is poorly developed. Important theories are cursorily introduced without sufficient depth for students to evaluate them in the context of the management actions that they attempt to justify. For

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example, the enemy release hypothesis (ERH), which states that introduced species become invasive by escaping the influence of their natural enemies, provides the underlying premise for biological control, but is never critically evaluated. In spite of this shortfall, ERH is dogmatically invoked to explain and justify all manner of biological control activities. Although ERH is no more a prerequisite for successful control than successful control is evidence in support of it [1], understanding the underlying nature of biological invasions is necessary to move biological control forward from a business of seemingly haphazard success to a predictive science. Some recent studies provide support for ERH as it relates to plant pathogens and their antagonists, particularly with regard to positive and negative soil feedbacks [2,3], whereas others suggest that novel interactions supercede natural enemies in determining invader success [4]. Although none of these studies provides conclusive evidence for or against ERH [1], they do have important implications for the theory and application of biological control. If factors other than natural enemies determine invader success, why should introduced natural enemies control them? This does not follow from ERH. Alternatively, if microbes are the real forces behind enemy release, then they might offer the greatest potential for successful control. Yet, microbes are currently little used in biological control.

With regard to nontarget effects (NTEs), the most controversial aspect of biological control, Hajek's overt conclusion is that NTEs result from past failures that no longer apply to contemporary biological control, a theme that is revisited throughout the book. As a field, biological control has historically taken the stance that, because biological control agents are generally more host specific than are chemical pesticides, NTEs from biological control are relatively unimportant. Increased emphasis on host specificity has certainly reduced NTEs, but NTEs are still

a reality of contemporary biological control [5–7] that can even include threats to human health [8], and current safety protocols do not fully guard against these. Although some of this research is too recent to have been incorporated into Hajek's book, most is not, and disregarding NTEs as a thing of the past only serves to hinder future progress in biological control.

Hajek states that biological control has contributed much to ecological theory, but that ecological theory has offered little in return to biological control. I suggest this situation has arisen because few biological control practitioners have made the effort to incorporate applicable ecological theory. Unfortunately, in this regard, *Natural Enemies* is another case in point.

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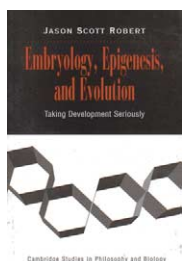
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Expelling genomania from evolution, development, and evo-devo

Embryology, Epigenesis, and Evolution: Taking Development Seriously edited by Jason Scott Robert, Cambridge University Press, 2004. £40.00 hbk (174 pages) ISBN 0521824672

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The central theme of Jason Scott Robert's book *Embryology, Epigenesis, and Evolution: Taking Development Seriously*, as you might guess from the title, is that 'our understanding of biology depends on our understanding of development.' As an evolutionary developmental biologist, I couldn't agree more with Robert's assessment

and this has been a hot topic in the field of evo-devo for some time [1–3]. According to the frontispiece, and the author, this is one of the first philosophical analyses of developmental biology and evolution. Robert's main argument is that the current, trendy and quite lucrative paradigm of the gene and the genome as primary agents in phenotypic evolution is incomplete, inappropriate and just plain wrong because this assumption of genetic primacy neglects the crucially important epigenetic factors that are necessary to get from the genotype to the phenotype. Robert is a well published philosopher of biology who has

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