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Book review

STADLER, B. & DIXON, A.F.G. 2008: Mutualism: ants and their insect partners

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Bernhard STADLER and Tony DIXON have made a useful contribution to the study of ant ecology and evolution with this book. Its title is an apt description, as the first half is a theoretical discussion of mutualism (cooperative interactions between species), while the second half deals with ants and their insect partners. This is fundamentally a conceptually-based book about mutualism; it is not intended to be an exhaustive survey of our current knowledge of the natural history of these systems. Its goal is to use a variety of interactions between ants and their exudate-secreting partners as case studies to highlight concepts.

STADLER and DIXON's theoretical discussion of mutualism should be of widespread interest. Researchers who do not work on ant-insect systems should not be deterred by the book's title, because the theory it reviews is applicable to a wide range of mutualistic systems. The authors make a welcome and much-needed call for starting with a conceptual and theoretical framework when analyzing these interactions. The evolutionary theory they have chosen to highlight at the beginning of the chapter stems mostly from the large body of work on within-species cooperation, some of which (at least as presently developed) isn't terribly applicable to between-species cooperation; they have missed some more relevant evolutionary theory published 2004 - 2007. This shortcoming, however, is more than balanced by their large section on ecological models of mutualism, which has no real parallel in any other volume. Lotka-Volterra, life-history, and metapopulation models are all discussed in detail. In the following sections of the book, the authors attempt to relate these models to case studies of ant-hemipteran (and ant-lycaenid) interactions. We found their use of life-history modeling in an ant-aphid system to be particularly interesting. The section on multitrophic interactions has a nice discussion of top-down and bottom-up effects on mutualisms. They build on the models introduced earlier to discuss the usefulness of generational time ratios (GTR) for understanding the outcomes of ant-insect interactions, and propose expanded use of this tool in the future. The one recent research area that is missing is the ecological networks approach to mutualisms, pioneered by Jordi Bascompte and others. Most of this rapidly grow-

ing literature has appeared since 2006, postdating most of the work reviewed in this volume.

The authors' coverage of natural history and background information about ant-insect mutualisms is less definitive. The terms Hemiptera and Homoptera are used interchangeably (to an entomological audience, this is not nitpicking: Homoptera is an abandoned name formerly used to describe a paraphyletic group). There is more information available in the literature on ant nutrition than they suggest. In fact, many ant-related topics could have been discussed in more depth; for example, they only briefly mention potentially important behavioral adaptations used in insect-tending, such as polydomy, trails, and recruitment. The authors imply that the only way to measure aggressiveness in ants is "a crude classification based on behavior like biting, stinging, spraying of formic acid or mass recruitment." (p. 72). The current literature actually proposes much more precise measures of aggressiveness than these. The background information presented here on hemipterans and lycaenids is more thorough, reflecting the authors' own expertise with these organisms. In fact, the book as a whole takes the perspective more of the tendees rather than the tenders (i.e., the ants).

Readers may be interested in similarities and differences between this volume and another very recent book dealing with mutualistic interactions involving ants, Victor RICO-GRAY and Paulo OLIVEIRA's (2007) *The ecology and evolution of ant-plant interactions* (University of Chicago Press, Chicago). RICO-GRAY and OLIVEIRA's scope of coverage is larger, but a full chapter is devoted to ant-hemipteran interactions. They generally approach these systems from the perspective of measuring plant fitness, although for certain cases they also look at outcomes for the hemipteran partner. RICO-GRAY and OLIVEIRA have a greater depth of knowledge of the current literature on some topics; conversely, they present less of a theoretical context and none of the general discussion of mutualism that makes the STADLER and DIXON volume so useful. The books complement each other nicely. Although neither volume takes the ant perspective, a myrmecologist interested in ant-hemipteran interactions would want to own both of them.

In summary, we found STADLER and DIXON's book to be a generally excellent summary of the conceptual and theoretical underpinnings of mutualism, including but not restricted to examples involving ants and their insect partners. Coverage of those cases is solid, although more so from the perspective of the insects that ants tend than from the perspective of the ants themselves. The authors have understandably chosen to take advantage of their own extensive expertise, particularly with regard to the biology of ant-tended Hemiptera. In light of its considerable strengths, anyone who works with ant-insect systems should consider this as essential volume for their shelves.

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Artikel/Article: [Book review. 138](#)