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## Book review

### RICO-GRAY, V. & OLIVEIRA, P.S. 2007: The ecology and evolution of ant-plant interactions

University of Chicago Press, Chicago, IL, 320 pp. Cloth: ISBN 978-0-226-71347-2, USD 70.00; paper: ISBN 978-0-226-71348-9, USD 28.00

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Hundreds of tropical plant species are the obligate hosts of ant colonies that nest within hollow branches, stems, or leaves. These so-called ant-plants (or myrmecophytes) were described by some of the earliest European ecologists who visited America (COBO 1653, AUBLET 1775 as cited in WHEELER 1942; BELT 1874). Even more plants secrete extrafloral nectar in order to attract defending ants from the vicinity (BENTLEY 1977, HEIL 2008). It has long been discussed whether resident ant colonies of myrmecophytes – or ants that visit extrafloral nectaries – indeed function as an indirect defence (HEIL 2008) or whether extrafloral nectar is the secretion of "excess carbohydrates". Research in the 1960s and 1970s was mainly devoted to the refutation of this anti-adaptationist hypothesis. Since then, research on symbiotic and non-symbiotic ant-plant interactions has increasingly focused on their biochemistry, phylogenetic history and ecological relevance. Several interactions even became standard models in ecology and evolution (HEIL & MCKEY 2003).

How important and diverse ant-plant interactions are can be seen in the book *The ecology and evolution of ant-plant interactions* by Victor Rico-Gray and Paulo S. Oliveira. The Mexican and the Brazilian ecologist teamed up to produce more than 300 pages of detailed information on everything that ants can do with plants. The book is the first on the topic since the works by HÖLLDOBLER & WILSON (1990) and HUXLEY & CUTLER (1991) and provides us with a detailed overview of recent developments. The authors have not followed the traditional separation of topics into antagonisms such as granivory and leaf cutting and mutualisms such as protection or nutrition of plants by ants, but instead cover the whole spectrum of interactions. They cover facultative interactions among, for example, plants and seed-dispersing ants as well as the most highly co-evolved, mutualistic interactions: those between myrmecophytes and their specialised defenders. Rico-Gray & Oliveira put great emphasis on the temporal and geographical variability of interactions and point out the problems that arise from generalisations of studies that have been conducted only at one site and during one season.

The authors use intriguing examples to demonstrate that the traditional, sharp separation of mutualism and antagonism hampers a more complete understanding of ant-plant interactions. For example, leaf-cutting ants are clearly antagonistic towards the plants they use, but they interact mutualistically with their fungus, which consequently represents an indirect antagonist of the plants. The fungus, in

turn, is under danger from "weed" fungi and even pathogens, from which it is mechanically and chemically protected by the tending ants. Hence, the ants are involved in further antagonistic interactions with the competitors and pathogens of their fungus. Depending on which pair of species we observe we see mutualism, grazing, parasitism or competition. However, all interactions necessarily co-occur and interact – they cannot be separated from each other if we wish to obtain a complete understanding of the interactions and their impact on the ecosystem. Similarly, many mutualisms have evolved from antagonistic interactions, as is most obviously the case for seed dispersing ants and for the indirect defence of plants by extrafloral nectar-feeding (and thus principally herbivorous) ants. By emphasising the fact that antagonisms and mutualisms – though apparently distinct – are connected by many intermediate stages, and explaining how they can arise from each other, the authors do a great job in overcoming the human-made categorisation of interactions that in fact form a continuum of possible outcomes.

In a successful attempt to cover everything that has been published on ant-plant interactions in the last ten or more years, the authors cite some 60 pages of references. This high number of citations and the detailed way in which many studies are discussed might represent a major challenge for readers who do not already have some background knowledge on ant-plant interactions. While a highly welcome contribution for those familiar with the topic, the book appears less suitable for students new to the field. In this context, a summarising introduction providing the non-specialist reader with a synopsis of the most important ant-plant interactions and their general roles in the ecosystem would have been welcome. In summary, the book indeed can answer the question "What is going on in the interacting worlds of ants and plants?" – but only if you are willing to study it completely.

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