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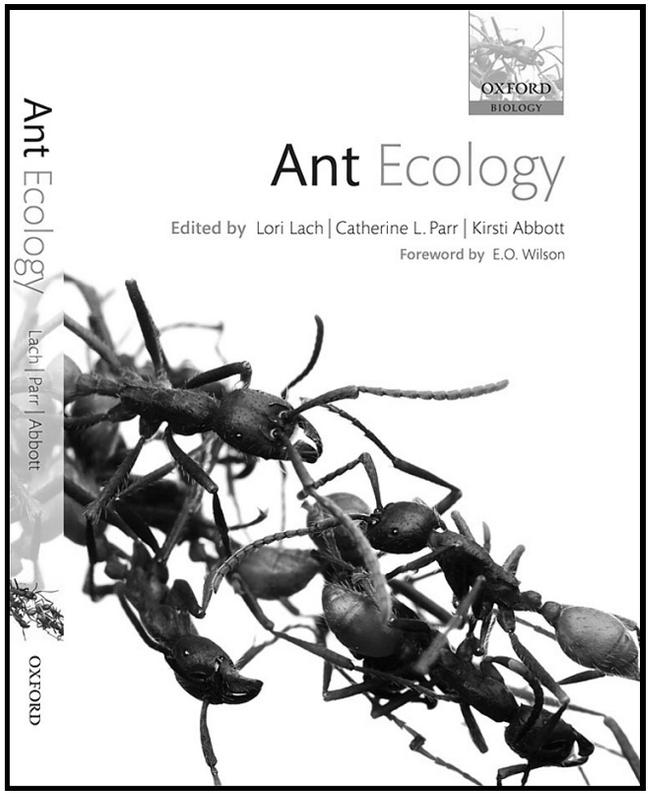
Book review

ANT ECOLOGY. 2010. Edited by L. Lach, C. L. Parr & K. L. Abbott. Oxford University Press, xviii + 402 pp. US $ 53 paperback

Ants are among the most conspicuous and important insects in terrestrial ecosystems, due to their abundance, long history and diversity with over 12,000 extant species described so far. Their presence and dominance are key factors influencing the structure and dynamics of tropical forests and even agroecosystems. The literature on ant ecology, like the literature on other aspects of ant biology, is naturally enormous, with thousands of publications. In 1990, Hölldobler and Wilson published "The Ants", a wonderful treatise which has exalted young scientists and stimulated them to do research on these insects. Lach, Parr and Abbott clearly belong to this new generation of enthusiast myrmecologists. With their book, they provide the first comprehensive review focusing on ant ecology since "The Ants".

The book is divided into 16 chapters grouped in four parts, plus a glossary and a series of plates with color photographs. Including the three editors, 53 authors contributed to the different chapters. The first part (Global Ant Diversity and Conservation) includes chapters on ant systematics, biogeography, geographic gradients and conservation. The systematics chapter, written by a world authority, Phil Ward, summarizes the various recent proposals in phylogeny and evolution at the level of subfamilies. We learn that the monophyly of Formicidae and most of its subfamilies is well supported by both molecular and morphological studies, except for Amblyoponinae and Cerapachyinae. However, there is no certainty about the relationships between subfamilies, especially within the poneroid complex, which seems to be an artificial group. Recent phylogenic studies (Kück *et al*. 2011; Moreau & Bell 2013) still provide uncertain results concerning the respective positions of the subfamilies Martialinae and Leptanillinae, which seem to be the sister groups to all remaining ants. Fisher explains in his chapter on biogeography that ants seem to have diversified after the breakup of Gondawana, in the Upper Cretaceous, in concordance with fossil data (LaPolla *et al*. 2013). Dunn *et al.* thoroughly explore geographic gradients in ant diversity, body size, range size and other life-history traits, seeking explanations for differences in speciation and extinction rates, and relationship between climate and patterns of local and global ant diversity. Some of these aspects may, in part, explain the gradual decrease of ant species richness with latitude and elevation, but there is still much to be investigated! In particular, the authors remark that most studies of patterns in ant diversity and composition have been correlative and they conclude with a call for a more experimental approach. Finally, Alonso explores the relatively little-studied but important topic of ant conservation. It is clear that for many ants there is not the slightest information on their distribution and extinction risk. The second part (Community Dynamics) includes chapters on competition, mutualisms, influence of resources on ant ecology, and ant diversity and function in disturbed habitats. Parr and Gibb review the vast literature on competition within and between ant species, and the role of dominant ants in the structure of local assemblages. They show that existence of competition is often difficult to demonstrate with confidence, and that the strength of competitive interactions is highly context-dependent. Although Parr and Gibb conclude that competition is undoubtedly an important factor in ant ecology, the reader understands that competition is not the predominant structuring factor as it was suspected to be (*e.g.* Hölldobler & Wilson (1990) described competition as the "hallmark of ant ecology"). This feeling was confirmed by recent papers (Parr and Gibb 2012; Cerdá *et al.* 2013; Stuble *et al*. 2013). Ness *et al*. review one of the most interesting topics of ant biology, namely mutualistic interactions between ants and other organisms such as Lepidoptera, Hemiptera, plants, fungi, and bacteria. Although several of these associations are relatively well studied, authors demonstrate that there is still much to explore regarding the scope of the expected costs and benefits of each association, its origin and dynamics over time and space, and the influence of these interactions on the diversity of its components. Blüthgen and Feldhaar address the issue of the influence of food and shelter resources on ant ecology. Clearly these factors are very important to the structure of ant communities (*e.g*. size and location of the colonies; species coexistence; etc.). Although the vast majority of ants are omnivorous (rare in other Hymenoptera), some have specialized diets and, for others like the enigmatic *Martialis* or *Tatuidris*, we simply do not know what they may eat. The



use of stable isotopes to study ant trophic position and the impact of gut microsymbionts or specific intracellular endosymbionts on ant nutritional balance are some of the new and exciting avenues of research in ant ecology discussed by the authors. Philpott *et al*. deal with a crucial question: how ant diversity and function are affected by disturbance and changing environments? Like other insects, ants are not immune to changes in their environment such as deforestation, mining or other space invasions for human "development". As a result, habitat disturbance can drastically alter ant diversity, function, and services. This in turn can affect other components of the ecosystem due to the numerous interactions ants maintain with other organisms.

The third part of the book deals with population ecology. Peeters and Molet summarize the rich and extensive literature on reproduction and life histories in ants. This is a dense and complex issue, with amazing life strategies, far beyond the oversimplified idea we may have of a typical colony (and probably in the close future, with the study of additional species and the accumulation of fascinating discoveries, we could no longer speak about "typical" ants). In the next chapter, Steiner *et al*. explain the structure of ant colony (another complex subject!) and provide a wealth of details about number of queens per colony, caste interactions, task allocation or nest properties (number, size and architecture). They underline the influence of both proximate and ultimate factors on ant colony structure, and they discuss the ecological consequences of colony structure on different levels of the ecosystem, from the colony itself to the abiotic environment. For these authors, there are nine elements that shape the colonies: genetics and gene flow, morphology, chemical signals, nutrition, habitat, pathogen and parasite load, cooperation and conflict in the colony, age of the colony, and chance. A key aspect of the success of the ants (and other social insects) has been, without doubt, communication, mainly based on signal chemistry. This topic is covered by d'Ettorre and Lenoir in their chapter on nestmate recognition. The latter seems to be mainly based on cuticular hydrocarbons. The subject of this chapter (chemistry!) could afraid some readers but the information is so clearly (we could say pedagogically) presented that everyone would have the impression to smell the odorous world of ants! The last chapter of this third part is written by Dornhaus and Powell and covers the subject of foraging and defense strategies. Just as the issue of colony structure or breeding strategies, this is another vast topic with abundant literature. As the authors point out, the issue has generated theoretical concepts and algorithms which have helped a lot to understand ant foraging.

The fourth and final part is entirely devoted to the hot topic of invasive ants. Human activities have indeed altered the distribution of many ant species. Some of them have become global scourges or worldwide agricultural and medical pests. Among these species is the fire ant (*Solenopsis invicta* Buren, 1972) one of the most studied ants (Tschinkel 2007). Suarez *et al*. describe biogeographic and taxonomic patterns of roughly 200 species of ants that have established populations outside their native regions. Most invasive species belong to the larger ant subfamilies, namely Myrmicinae, Formicinae and Dolichoderinae, with some genera making the "top ten" of the most problematic ants: *Solenopsis, Wasmannia, Monomorium, Linepithema, Technomyrmex, Paratrechina* and *Hypoponera*. Study of invasive species has been very useful to establish patterns of invasion, to identify "donor" and "recipient" regions (we are sad to inform that South America has produced the greatest number of invasive ant species), and to determine attributes of successful invaders. Krushelnycky *et al*. explore deeper invasion processes and causes of success. Clearly this implies the sum of several factors, including tolerance to anthropogenic disturbance, transport probability, attributes of colonies and populations, and local biotic and abiotic conditions in the new habitats. Successful invasive ants such as the Argentine ant (*Linepithema humile* (Mayr, 1868)) and the little fire ant (*Wasmannia auropunctata* (Roger, 1863)) often share similar attributes (unicoloniality, polygyny, generalist diets, etc.) that allow them to outcompete native species. However, the authors note with reason that our knowledge of ant biological invasions is mostly based on the study of a handful of species, and they urge myrmecologists to include a higher number of species in their studies to provide a more comprehensive understanding of ant invasiveness. It is important since ant invasions are not only economically costly but also has huge consequences on ecosystems as explained by Lach and Hooper-Bui in the next chapter. The authors provide a synthetic but extensive survey of the relevant literature. Invasive ants alter not only native ant assemblages but also the different components of the ecosystems (invertebrates, vertebrates, plants, and soil are discussed). Once again, it is unfortunate that the majority of research has focused on only a few ant species (mostly *Anoplolepis gracilipes* (Smith, 1857)*, L. humile* and *S. invicta*) and a few native ones. Knowledge of the impact of invasive ants at the community level is missing but urgently needed. The last chapter (Hoffmann *et al*.) concerns the management of invasive ants. The authors bring us optimism since they show that prevention, control and eradication of invasive ant species are possible, at least in some conditions.

The book ends with a synthesis written by the editors. Interesting perspectives are also offered. By the way it is important to acknowledge the huge effort made by the editors to produce a coherent treatise despite the participation of 53 co-authors. In general, when so many authors collaborate boring repetitions, disjointed ideas or quality discrepancies occur among chapters. Not here! The scientific level is sound throughout the book.

Overall, the book covers well the most expected topics of the complex and vast subject of ant ecology, and its long list of references (over 65 double column pages) is a formidable source of information. There is one or the other issue left out or only briefly treated as ant mosaics in native forests and agricultural systems, or the ecology of some specific groups such as legionary ants, or mushroom cultivators. Sure, interested people can complement their knowledge by the reading of other publications that reinforce topics of this book. On the ecology and evolution of interactions between ants and plants the reader may refer to the excellent book of Rico-Gray and Oliveira (2007), on mutualisms to Stadler & Dixon (2008) or on colony dynamics to Gordon (2010).

The Neotropical Region has certainly played and plays an important role in the evolution and diversity of ants. Although these insects apparently originated in Laurasia during the Lower Cretaceous or Upper Jurassic, the first major diversification of lineages corresponds to the Late Cretaceous, and its geographic and ecological dominance can be observed since the Upper Eocene. The Neotropics have witnessed several waves of diversification of ant groups and host the richest fauna and the largest number

of endemic genera. Much of the book offers explanations about why ants are so successful, why it is worth studying them and, of course, why it is necessary to preserve them.

One final thought about the authorship of the book. Apart from two exceptions, all the 53 authors are from the USA, Europe or Australia. It is fine, of course, as these countries shelter hundreds of experienced myrmecologists with extensive experience in various aspects of ant ecology. But... Where are Latino American authors? The Neotropics is not only rich in ant species! It is also rich in researchers, teachers and students who explore various aspects of ant biology. Countries such as Mexico, Brazil and Argentina have institutions and researchers with significant contributions in any of the topics covered by the book. It is very strange and disappointing that this myrmecological community was ignored.

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