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Cambridge University Press
978-1-107-11607-8 — A Natural History of Ladybird Beetles
M. E. N. Majerus , Executive Editor H. E. Roy , P. M. J. Brown
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A Natural History of Ladybird Beetles

The Coccinellidae are a family of beetles, known variously as ladybirds or ladybugs. In Britain alone, some 46 species belong to the Coccinellidae family, although only 26 of these are recognisably ladybirds. Composed largely of Professor Michael Majerus' lifetime work, and updated by two leading experts in the field, this book reveals intriguing insights into ladybird biology from a global perspective. The popularity of this insect group has been captured through societal and cultural considerations coupled with detailed descriptions of complex scientific processes, to provide a comprehensive and accessible overview of these charismatic insects.

Bringing together many studies on ladybirds, this book has been organised into themes ranging from anatomy and physiology to ecology and evolution. This book is suitable for interested amateur enthusiasts and researchers involved with ladybirds, entomology and biological control.

Michael E.N. Majerus (1954–2009) was Professor of Genetics in the Department of Genetics at the University of Cambridge and Fellow of Clare College, Cambridge. He was a world authority in his field, a tireless advocate of evolution and an enthusiastic educator of graduate and undergraduate students.

Helen Roy is a Group Head and Principal Scientist at the NERC Centre for Ecology & Hydrology, where she leads zoological research within the Biological Records Centre (UK focus for terrestrial and freshwater species recording). She is an ecologist with a particular interest in the effects of environmental change on insect communities.

Peter Brown is an ecologist and Senior Lecturer in Zoology at Anglia Ruskin University, Cambridge, where he is also Course Leader for MSc Applied Wildlife Conservation. His research for over ten years has focused on ladybird ecology and, with Helen Roy, he has co-authored two recent books on ladybirds.

Michael, Helen and Peter collaborated for many years and produced numerous peer-reviewed papers on various aspects of the biology of ladybirds.

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Editors' Foreword and Acknowledgements

It was with great pleasure and gratitude that we accepted the invitation from Cambridge University Press and Christina Majerus to work on this book. We both had the privilege of working with Professor Michael Majerus (Mike) and over the years had learnt so much from him, not only about ladybirds but also about his approaches to science in general. Mike was a mentor to many and the fondness with which he is remembered is testament to his inclusive approach, leading to collaborations far and wide. So it is particularly poignant that his last book has a global perspective building on his previous books on ladybirds (Majerus and Kearns, 1989; Majerus, 1994a).

Mike was a prolific and eloquent writer. He published many books throughout his lifetime and discussed the text for this book with us before his untimely death. He was inspired by the progress that had been made in the understanding of ladybird biology since the publication of the New Naturalist *Ladybirds* (1994a). The resulting book was beautifully written and represented an overview of ladybird biology organised in themes ranging from anatomy and physiology to ecology and evolution. In editing the book, we have endeavoured to ensure that changes to Mike's original text are minimal and that we have simply provided more recent research perspectives. We should also mention that we have not been alone in making these edits. A number of reviewers provided insightful comments and suggestions. We have endeavoured to address these.

So what have we added? Chapter 1, 'Ladybird, Ladybird…', provides cultural perspectives and is both richly detailed and beautifully written. We simply added a few references; perhaps the most significant was to note that the Naturalist Handbook that Mike had written with Peter Kearns in 1989 has now been revised and published (Roy et al., 2013). There have been a number of changes to the classification of ladybirds and throughout Chapter 2, 'The Structure of Ladybirds' (and subsequently the entire book), we have recognised the new taxonomy, which is outlined in detail by Nedvěd and Kovár (2012).

We worked with Mike to plan *Ladybirds (Coccinellidae) of Britain and Ireland* (Roy et al., 2011) and information gathered by volunteers and submitted to the UK Ladybird Survey (www.ladybird-survey.org) has enhanced our understanding of the associations of ladybirds with other species and their habitat associations. Therefore, we were able to add to Chapter 3, 'Where Ladybirds Live'. Indeed, new technology, vertical-looking radar, has been used to examine flight patterns of ladybirds (Jeffries et al., 2013). Mike published a number of

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studies on intraguild predation, mainly in response to the arrival of *Harmonia axyridis*, an alien species that Mike described as the 'most invasive ladybird on Earth'. Many people have prolifically continued this research theme and therefore we have included an overview of intraguild predation within Chapter 4, 'What Ladybirds Eat'.

Mike was an evolutionary ecologist and his fascination for this topic is revealed through Chapter 5, 'Sex and Reproduction'. This extensive chapter highlights Mike's deep understanding and represents colloquial reflections coupled with detailed description of complex scientific processes. There have been a number of advances in the field, particularly through molecular studies on paternity (Haddrill et al., 2002, 2008), that Mike would have been aware of but that have only been recently published. There is no doubt that this was the most difficult chapter for us to edit, because it represents the focus of Mike's incredible research profile. There was little we could add.

There had been few studies on the overwintering of ladybirds but over the last few years a number of publications have addressed this gap. There have been a number of recent publications on aggregation pheromones and winter survival of ladybirds that were worthy of addition to Chapter 6, 'Ladybird Dormancy'. Field studies on overwintering are particularly lacking but recent research such as that of Ceryngier and Godeau (2013) assessing the negative relationship between soil humidity and abundance of overwintering *Vibidia 12-guttata* are advancing understanding.

Chapter 7, 'Ladybird Death', has been a source of fascination for many researchers. Mike was no exception and his breadth of understanding from defensive chemistry to parasite taxonomy was impressive. The cocktail of chemicals used by ladybirds for defence continue to be a source of intrigue. Laurent et al. (2005) noted that more than 50 alkaloids have been identified across the coccinellid family. Mike had already noted that *H. axyridis* was more resistant to parasites compared to other ladybirds. There has been further work in this regard and evidence suggests that the species has arrived in enemy-free space within the invaded range (Comont et al., 2014) but may be host to hitchhikers (Vilcinskas et al., 2013). Research on the role of natural enemies in shaping ladybird assemblages is set to continue and the male-killing symbionts that captivated Mike are particularly appealing study organisms.

It is enjoyable to think back to discussions with Mike on the conundrum of colour pattern polymorphism in aposematic ladybirds. The evolutionary links between the defensive chemistry and elytral patterning were described by Mike in Chapter 8, 'Ladybird Colouration', in which he poses three questions. Firstly, how does true warning colouration evolve? Secondly, why do all species of ladybird not look more or less the same? Thirdly, why is there so

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much colour pattern variation among individuals in some species of ladybird? Throughout the book Mike explores these evolutionary perspectives. A recent study by one of Mike's students examines the effects of temperature during pupation on the spot size of *H. axyridis* (Michie et al., 2010). There is still much to reveal about the evolutionary and ecological relevance of colour pattern variation, but Mike's overview throughout Chapter 9, 'Variation and Evolution in Ladybirds', will certainly provide inspiration for further studies in this area.

The final chapter, 'Ladybirds and People', provides a detailed cultural perspective alongside reflections on the beneficial role played by ladybirds through control of pest insects. Mike celebrates ladybirds as biological control agents while recognising that his concerns over the threat posed to biodiversity by *H. axyridis* are symptomatic of wider problems of increasing arrivals of invasive alien species globally. He states: 'many accidentally introduced species have had little or no effect on native ecosystems, and many agricultural and biological control species have been beneficial, but the impacts of some alien species have been highly undesirable' and that 'Biotic homogenisation now has widely recognised ecological and evolutionary consequences and is considered among the greatest threats to biodiversity (Olden et al., 2006).'

We have added a substantial number of new images throughout the book and are grateful to all of the photographers who kindly gave permission for their images to be reproduced. We are especially grateful to Gilles San Martin, who provided many superb photographs, including that featured on the front cover. We would also like to thank Matt Tinsley (University of Stirling), a PhD student with Mike in the 1990s, who commented on the male-killing section within Chapter 7 Olda Nedvěd kindly checked the taxonomy throughout.

We hope that you will enjoy this book as much as we have done. It will be a pleasure to read it again and again but for now we leave this editorial with Mike's words:

> I also enjoy speculating. In this book I will do so liberally. If others, who are caught up in a fascination of ladybirds as much as I have been in the last quarter of a century, subsequently put my ideas and theories to the test, I will be delighted, whether my ideas are verified or refuted.

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