BOOK REVIEW OF "BIRDS & FLOWERS: AN INTIMATE 50 MILLION YEAR RELATIONSHIP" BY JEFF OLLERTON

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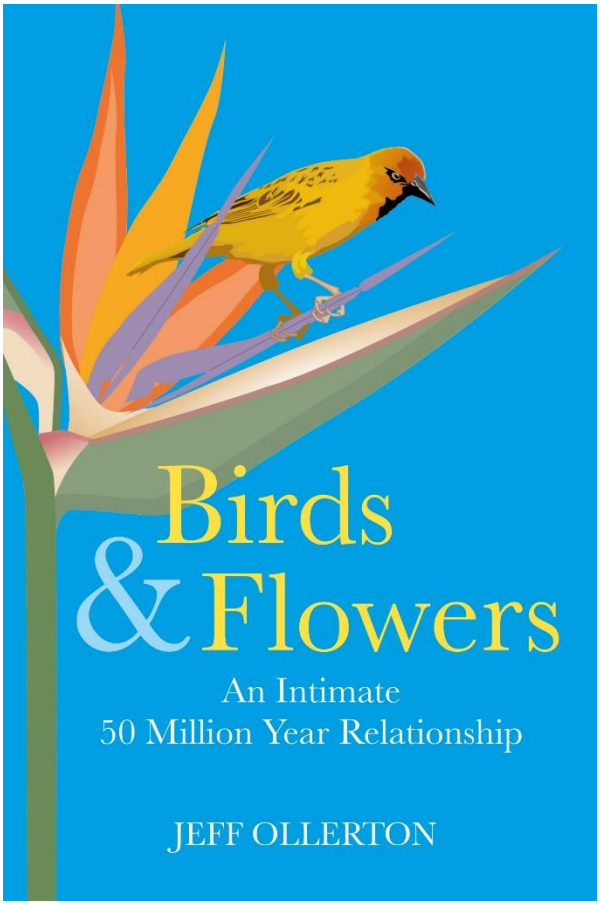
REVIEW

Few pollination biologists have done more in this modern era than Jeff Ollerton to engage and inform the public about interactions between plants and pollinators. In this delightful book, he describes the ways that birds and flowers interact. As in his previous book, *Pollinators & Pollination: Nature and Society*, Ollerton takes a deeply personal approach to the subject. He combines anecdotes from his research travels around the world, to mountains of Kenya and Tanzania, the Andes of Peru, Brazil, and Nepal, among other places, with his contributions to, and masterful knowledge of, the recent literature gained as a world-renowned pollination biologist. Ollerton is widely cited, especially for his estimate of how many flowering plants are pollinated by animals (Ollerton et al. 2011) and his piece with Nick Waser and other colleagues on generalization in pollination systems (Waser et al. 1996). The introduction to the book opens with an account of him on the slopes of Mount Kenya identifying sunbirds foraging at nectar of bottlebrush, a tree that evolved on a different continent (Australia) and would normally attract honeyeater birds. It then moves quickly into raising the question of why flowers should evolve interactions with pollinating birds at all when insects got there first, and then into an account of the earliest known fossil bird with pollen preserved in its gut (48 mya). Sources from the scientific literature are provided, but in a separate section at the end of the book so that the story-like narrative is not interrupted. This style, enmeshing the personal with the professional, makes the book highly engaging with appeal to a broad audience. It is beautifully illustrated with 28 color plates.

One of the recurring and fascinating themes is the high diversity of pollinating birds. They are not restricted to the hummingbirds of the New World and the well-known sunbirds and honeyeaters. Ollerton estimates that at least 12.5% of bird species visit flowers for food, and that over one quarter of bird families contain species that visit flowers. A few examples: some woodpeckers take nectar, and birds are pollinators for almost a third of cacti species. Also early in the book, Ollerton makes the important distinction between a plant being pollinated by birds and having floral traits associated with bird pollination. He introduces the idea of pollination syndromes and provides a balanced view of the controversy over their use, noting his global analysis finding that the syndrome only correctly predicted flower visitors 30% of the time (Ollerton et al. 2009).

A second theme of the book is the ecology of interactions between birds and flowers, and this occupies much of the middle section. He considers the often misaligned interests of birds and plants, stressing that "mutualisms are really about mutual exploitation" and addresses the role of sensory capabilities of birds. Here he focuses mainly on colour vision and the relationship with flower colour, but also dissects the textbook fallacy that birds do not use scent to find flowers and notes how little we still know about how often, and how, they do respond to scent in flowers. Scent is an



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important attractant to many pollinators, but because it is technically more difficult to study has received less attention than other floral features. Although hummingbird-pollinated flowers are generally weakly scented, they do often emit volatile compounds that produce some scent (Raguso et al. 2003; Bischoff et al. 2014).

As to be expected in any book this personal, certain study approaches are emphasized more than others. Many of the examples cited provide data on interaction networks (which birds visit which plant species) or on the effectiveness of birds at transferring pollen and effecting seed set (showing that they are pollinators). In discussing the geographical scope of interactions, Ollerton takes us to the Galápagos and notes that 19 of the 23 species of land birds, including most of the Darwin's finches and a rare example of a cuckoo, feed on flowers and transport pollen (Traveset et al. 2015). This is an astonishing example of 'interaction release' on islands, and one that I too was entranced by when I read about it prior to visiting those islands. In some cases, studies of how effective birds are at depositing pollen has revealed the role of bird pollination in unsuspected places, including pollination of *Anagyris foetida* (Fabaceae) by birds such as the Common Chiffchaff in Spain. Readers may be too enthralled to miss any topics less covered, but for those who want comprehensive coverage, what topics receive less emphasis? In comparison with a recent review of bird pollination (Pauw 2019), less emphasis is given to natural selection by plants on bird traits, and also to how shape or other aspects of morphology of bird-pollinated flowers affect aspects of plant fitness, especially those that might differ from flower visitation. Floral morphology is certainly discussed, but not the rich complexity of how traits such as width or length of a tube, positioning of anthers, flexible pedicels, or spur curvature affects the amount of pollen removed, where it goes on a bird, or how much pollen is dispersed (Campbell et al. 1996; Fulton & Hodges 1999; Kay 2006; LoPresti et al. 2019). Such aspects of microevolution can provide a link between the ecology and macroevolution.

The final part of the book brings in relationships with humans, including aspects of art, gardens, and agriculture. Ollerton provides an amazing example of a ceramic pot from the Nazca culture of Peru that depicts not only birds interacting with flowers (illustrating ecology) but also several species of hummingbirds doing so. Some of the color plates illustrate examples of bird-flower interactions on common objects, including a guitar, wine bottles, and beer bottle. These pictorial images are common now, with hummingbirds and flowers often depicted on T-shirts, and my lab at the Rocky Mountain Biological Laboratory has adopted its own unofficial beer can brewed in Colorado that shows not only hummingbirds but also flowers of several species of plants we study. The book ends with a pair of chapters, one that discusses extinction of ecological interactions and one that provides some ideas for restoring hope. The bad news is that 15% of hummingbird species face serious conservation challenges, one-third of white-eyes and their relatives are threatened, and all five species of Hawaiian honeyeaters are extinct. I love that the book ends on a note of hope, providing some

examples where restored sites have similar diversity of pollinating birds or similar pollination services to undisturbed areas. That is an important message.

This book would be a great choice for an undergraduate seminar on pollination and would also work well for a graduate student seminar. But it will also appeal to professional pollination biologists, birders and casual botanists, as well as other members of the general public. All will learn not only about interactions between birds and flowers but also something of scientists as people. One of the greatest joys of my backyard garden is the many hummingbirds I see at flowers. Any of us similarly entranced by interactions between birds and flowers, or by pollination ecology in general, would greatly enjoy this book. It fills a unique niche, focusing on interactions between two of the most loved groups of organisms and doing so in a highly engaging yet highly informative way.

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