

Bee Power

BOOK REVIEW

Our Native Bees – North America’s Endangered Pollinators and the Fight to Save Them, by Paige Embry. 2018. Timber Press, Portland OR. 224 pp.
[ISBN 9781604697698 (hardcover); ISBN 9781604698411 (e-book)]

Reviewed by:
MIKE ARDUSER¹

Bees have dominated the front pages of insect news for the past decade, headlining stories that often simmer with doom and gloom, inspiring hand-wringing about an impending bee apocalypse. Should we worry?

In this book, an epiphany involving tomato pollination springboards author, veteran gardener and self-confessed bee novice Paige Embry into the world of North American bees and what they mean to us. Her style is personal and inviting, and we willingly take the journey with her. Along the way we get to know a host of “bee people”: those working with bees in agriculture and research, and those working with bees simply because they love them. The author explores several “big questions” about bees direct from the headlines, bringing in many current or recent bee research projects, tying their results to broader bee issues, provides references for each chapter and a Further Reading section as well as a list of relevant websites. Though clearly not a field guide to bees, there are ninety-one splendid to spectacular color photographs of various bee species, ably demonstrating their diversity; most images are accompanied by a brief explanatory text box.

After a very brief introduction to pollination and bees, the book begins not with native bees as the title might suggest, but with a chapter on the European honey bee, the six-legged workhorse of modern agriculture. The chapter serves as a framework for the first half of the book, and the following four chapters explore the agricultural importance, potential, and management of our native bees, including bumblebees, the blue orchard bee (*Osmia lignaria*), and others, as well as some of the problems they face (e.g., pesticides, diseases). The recent Federal listing as Endangered of the rusty-patched bumblebee (*Bombus affinis*), once very common in much of the eastern US, happened after the completion of the book, and so isn’t discussed. However, the probable extinction of a related species, Franklin’s bumblebee (*Bombus franklini*), and the likelihood of a similar cause of decline between the two species (and several other species) is

¹ MIKE ARDUSER — Conservation Research Institute, Cedarburg, WI 53012.
email: arduser.michael@gmail.com

brought out in some detail. There is a chapter on cleptoparasitic bees (cuckoo or cowbird bees), and the remaining chapters address what the general public can do – and is doing – to conserve native bees from golf courses to backyards and lawns.

Given the book's title, I expected a portion of it, a chapter at least, dedicated to an overview of the status of our native bees, but there are only two pages about the "state of bees in the wild." The book also suffers a bit from the lack of any serious discussion about the critical importance of bees to rare and endangered plants, or to natural communities in general. The extensive literature on pollination ecology could have been mined for numerous examples.

Several other important issues regarding native bees are treated lightly or not at all: introduced bees, including non-native Africanized bees, are barely mentioned. Given the exponential increase in the number of introduced species in the past two decades, the explosive near-nationwide spread of certain introduced megachilids (*Osmia cornifrons*, *O. taurus*, *Megachile sculpturalis*, *Anthidium manicatum*), and the steady northward march of Africanized bees into the southern United States, a chapter on exotics and their potential ecological impacts (and their potential value, in the opinion of some agricultural interests) would have been useful. Indeed, the two *Osmia* species mentioned above appear to be displacing native *Osmia* species, including the blue orchard bee, in much of the eastern US, and many urban bee surveys in the eastern US (including a recent survey in St. Louis) document the numerical dominance of exotic bees in cities.

Despite these criticisms, this is first and foremost a book about the interdependence between people and bees, and that is its strength. It should be read with that in mind. If you haven't yet embraced the power of bees and the urgency of conserving them, this book will convince you.

Smarter Than We Think?

BOOK REVIEW

The Revolutionary Genius of Plants, by Stefano Mancuso. 2018
(English translation; original copyright 2017). Atria Books, New York. 240 pp.
[ISBN 9781501187858 (cloth)]

Reviewed by:
DOUGLAS LADD¹

Subtitled *A new understanding of plant intelligence and behavior*, by a professor at Italy's University of Florence billed as the "world's leading plant neurobiologist," this book challenges the reader's assumptions and provides a well-grounded case for why humans have consistently underrated the ecological sophistication, adaptability, survival mechanisms, and sensory and memory capacity of plants.

Despite comprising more than 80% of the Earth's living biomass, plants have been underexplored by humans, and mostly from a utilitarian perspective; hence the 2,000+ new species of flowering plants still being described new to science each year, including 50-meter-tall trees. We tend to interpret plants through an animal-centric prism, and this same paradigm has suffused much of human knowledge, resulting in largely centralized structures and models in everything from engineering to delivery of services. Unlike animals, which mostly depend on mobility, survival of sessile organisms such as plants requires complex and adaptive decentralized mechanisms.

Here, in nine enjoyable chapters with catchy titles like "Memories without a Brain" and "Green Democracies," the author pleads for a more nuanced understanding of plants and makes the case that "plants have already provided the best solutions for most of the problems that afflict humanity." The author considers it no accident that some of the most successful human constructs, such as the internet, are modelled after the diffuse hierarchical organization of plants. The text is enhanced by numerous excellent and intriguing color images and photographs, including dramatic two-page spreads opening each chapter. It is a testimony to the quality of the translation that this work reads as if it was originally written in English.

The central tenet of the first half of the book is that plants have evolved survival strategies, including sophisticated sensory capabilities, inter- and intra-organism communications, and memory capacity. These systems are almost unrecognizable through the perceptual lens of animal-

¹ DOUGLAS LADD — Missouri Botanical Garden, 4344 Shaw Blvd., St. Louis, MO 63110.
email: dladd@tnc.org

based biology, and in many cases are more innovative, flexible, and cooperative than in animal systems. While initially surprising, this should not come as a shock given that we have long known that, from a biochemical perspective, plants are far more complex, capable, and sophisticated than are animals.

Despite lacking brains and nerves, plants can sense and react to subtle environmental variables along multiple gradients, and in many cases can communicate information about these conditions both within the plant and to other individuals. A key thesis of this work, of which I was initially highly skeptical, is that plants have a clearly documented capacity for memory. While these are not the neutrally imprinted memories associated with animals and their centralized brains, the author makes a compelling, documented case for the transfer and storage of information about environmental stimuli in plants through time. There are fascinating examples, including the ability of sensitive plant (the Neotropical *Mimosa pudica*, famed for its rapid leaf movement when touched) to ‘learn’ not to react to harmless stimuli while still reacting to novel stimuli. Astoundingly, the plants can remember these differences for 40 days despite lacking traditional memory storage apparatus. It turns out that Charles Darwin and his son wrote separate accounts about plant intelligence, Darwin senior noting that plants have capabilities “like the brains of lower animals”!

The author speculates on the conceptual and linguistic convolutions scientists have used since the 1700s to discuss these long-known phenomena without invoking the word ‘memory’ (acclimatization, priming, conditioning, etc.). These accounts lead to an insightful glimpse into the role of epigenetic mechanisms, including DNA methylation, in plant memory, all clearly explained and illustrated.

One of two shockers in the book is a discussion of how a South American liana (*Boquila trifoliata*) adapts its leaves to resemble the leaves of the plant on which it grows, with a single plant on multiple neighboring species sometimes displaying multiple leaf morphologies, each evocative of its nearest neighbor! (!!). This leads to an account of evolutionary drivers and potential mechanisms, culminating in a discussion of potential optical-sensing properties of plants, linking to long-forgotten British research proving the ability of some plant cells to moderate and focus images of their surroundings. Although still an unproven hypothesis: wow. [The other shocker in the book concerns the amazing ability of some plants to tune their extrafloral nectaries to first attract target insects, then to chemically adjust the nectar to biochemically enslave and weaponize the insects, with speculation on a similar example involving humans.]

The book includes many riveting examples of earlier researchers and their discoveries, some of which went unnoticed for centuries before being resurrected as research topics in recent years. Along the way, it is impossible not to absorb a panoply of interesting anecdotes and tidbits: →Prions may play a role in plant memory! →Galileo didn’t invent the telescope! →The telegraph plant, an Asian shrub, moves continuously! →Fall colors in deciduous trees are likely a boast to insects! →A single rye plant can have more than 100 million root apices! →The architecture of

London's Crystal Palace was derived from the structure of the giant water lily! →There is a special hot sauce that sells for thousands of dollars for a few milliliters! ...and so on. Not many books include passages linking Athenian democracy, collective decision making among social insects, jury theorem, and patterns of plant growth and development, but this work successfully unifies them.

There are vividly clear and detailed explanations of the complex and often overlooked structures and mechanisms plants have for everything from timing seed dispersal to planting themselves at the correct soil depth, and for adapting to being at a fixed location subject to predation and changing conditions (“animals try to avoid problems, plants solve them”). The signaling and sensing network of a root system, a brain-like neural network capable of assimilating and signaling vast quantities of real-time information, is convincingly posited as equivalent to the collective intelligence and behavioral adaptations of some social animals. It turns out that plant root system development may prove to be the best model for developing extraterrestrial exploration mechanisms, and can be effectively modelled using swarm behavior algorithms.

The final two chapters of the book are to me the least interesting and somewhat discordant from the rest of the text. These cover bioinspiration (=biologically inspired design; hardly a new field, as demonstrated even by examples in the book's previous chapters) and the author's current research and its extraterrestrial applications, including a detailed account of research on weightlessness in plants, and an overly self-focused account of the author's multiple zero-gravity simulator flights; these distracted from the overall impact and power of the rest of the book. There is a succinct bibliography of sources by chapter, with a preponderance of material from highly regarded, peer-reviewed journals.

Overall this is an enjoyable, informative, and even at times inspiring read that caused me to rethink some of my preconceptions after more than 40 years as a practicing botanist. If I have any criticisms, it is that at times the book does not adequately consider contemporary evolutionary theory, instead sometimes attempting to create an aura of mystery and imputed sentience. As mentioned previously, there are also lots of diversions – Soviet agricultural history, the history of the race to be the first to induce flowering in giant water lilies, etc. Readers will either find these fascinating or tedious and distracting, but to me they enhanced and anchored the themes of the book and I eagerly encountered each branching exploration like a shaman welcomes entheogens. In this case, I highly recommend the trip.