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BOOK REVIEW

Approaches to Plant Evolutionary Ecology by Gregory P. Cheplick. 2015. 312 pp. ISBN-13: 978-0199988327 $79.95 (hardcover), ebook available. Oxford University Press, New York, NY.

At its core, the discipline of plant evolutionary ecology is the study of microevolutionary adaptations, whether they are the evolution of resistance to toxic soils, new mutualisms with microbes and animals, or survival in a world changing rapidly due to pressures by humans. To understand those adaptations, the plant evolutionary ecologist uses a toolkit that has been developed and passed down by generations of scientists stretching back over the past century. The common garden experiments, pioneered by Gote Turesson and early silviculturists, as well as the reciprocal transplant experiments, mastered by Jens Clausen, David Keck, and William Hiesey, form the empirical keystone of the field, not to mention the modern evolutionary synthesis. "*Approaches to Plant Evolutionary Ecology*," by Gregory Cheplick, provides a comprehensive contemporary overview of the toolkit for adaptation studies and in doing so effectively passes the torch of the discipline onto the next generation.

One of the greatest strengths of the book is that it is written by a single author and follows a clear narrative logic, with the process of evolutionary adaptations being a unifying theme throughout. This makes it a perfect book for use in the classroom. The book is intended to be an introduction to the field for an advanced undergraduate or beginning graduate student. However, each subsection of the book is in itself a mini-review, which also makes it a valuable reference guide for senior scientists in the field.

As the word "approaches" in the title suggests, the book has a heavy emphasis on methodology, often opting for discussions of experimental design and analyses over addressing bigger fundamental questions. This is a major strength though, as the book will serve well as a "how to" training guide for a budding scientist. However, this approach could also be considered a weakness, as it does not clearly articulate a path for combining the results of all the studies Cheplick cites into an exciting deeper synthesis. Accomplishing both goals in a single book would be an epic challenge and Cheplick has wisely chosen to focus on developing a well-crafted

field guide to the experimental design and analytical approaches of Plant Evolutionary Ecology.

The book can be divided into two major sections. In the first section, the reader is introduced to the Plant Evolutionary Ecology toolkit, which includes genotype x environment interactions, selection gradients, and path analyses (Chapter 2), common garden experiments (Chapter 3), reciprocal transplant experiments (Chapter 4), and molecular methods (Chapter 5). In the second half of the book, Cheplick demonstrates how that toolbox can be applied to understand both abiotic (Chapter 6) and biotic (Chapters 7, 8, 9) agents of selection. I found this organization to be very effective, as it firsts introduces concepts and then reinforces those concepts through multiple empirical examples. The book is greater than the sum of its component chapters.

Any of the chapters could easily be a book on its own, a fact that Cheplick reiterates many times. Thus, it is quite a feat that the book covers the literature as thoroughly as it does and identifies so many avenues of research that need further exploration. Each chapter is filled with useful tables and figures that help to highlight the key discoveries of all of the various sub-disciplines covered in the book. There are also many key reoccurring themes throughout the book. For example, reciprocal transplant experiments have provided us with strong evidence for local adaptation in many systems, but we often have a poor understanding of the relative importance of various agents of selection driving adaptation in those systems. By spending time on each of the potential agents of selection in the second half of the book, Cheplick provides the experimental framework for identifying those agents of selection and establishing their relative importance.

Throughout the book, each key concept is built from a foundation established by the classic literature. This approach makes a lot of sense for common garden and reciprocal transplant experiments, which are fundamentally the same today as when established by Turesson, Clausen, Keck, and Heisey. These types of field experiments have aged well with time and still provide new insights into the mechanisms of adaptation. Unfortunately, classic molecular methods have far worse of a shelf life than classic field experiments. Chapter 5, which is dedicated to molecular methods, spends far too much time discussing molecular makers (allozymes, RAPDs, AFLPs) that were largely outdated when I started graduate school over a decade ago. Anyone scanning the table of

contents of the most recent issue of the journal Molecular Ecology will clearly see that studies of evolutionary ecology now routinely use high-throughput sequencing. High-throughput sequencing provides far more useful data and is generally more cost effective than classic markers, but is barely touched in Cheplick's review of the state of the field. Fortunately, there has been a deluge of recent review papers written on molecular approaches for understanding the evolutionary ecology of adaptation. A few of those review papers (Savolainen et al. 2013; Tiffin & Ross-Ibarra 2014) could easily serve as companions to Chapter 5 in order to provide a modern perspective on the field. While Chapter 5 is the book's weakest link for multiple reasons, the rest of the chapters are very strong and hold the narrative together.

Overall, Cheplick's book exposed me to many excellent studies, both classic and contemporary, of which I was previously unaware. It also opened my eyes to new avenues of research and reinforced some key concepts that had become rusty with time. I even got some new ideas for research projects. I think that others will find the book similarly illuminating and I certainly plan on encouraging students interested in Plant Evolutionary Ecology to read this book.

LITERATURE CITED

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Tiffin, P. and J. Ross-Ibarra. 2014. Advances and limits of using population genetics to understand local adaptation. Trends Ecol. Evol. 29: 673–680.

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