

than the broader scope of traditional palynology that includes any microscope organic walled organism.

Chapters 11-21 illustrate the value of pollen studies to agriculture, horticulture, forensic science, honey production, paleoecology, taxonomy, plant evolution and meteorology. Seven chapters are devoted exclusively to aerobiology and allergies caused by mold spores and pollen. These chapters include the contributions from 19<sup>th</sup> and 20<sup>th</sup> century aerobiologists, the design, advantage and disadvantages of various gravitational settling sampling devices, pollen/spore calendars from India, Taiwan, Australia, North America and Europe, and source plants (ragweed, grasses, and birch) of common allergens. The authors describe how weather patterns, geographical location, latitude, elevation, and heredity affect the severity of asthma and other respiratory problems, and note that pollen allergies have been recorded in horses, dogs and other mammals. They show how pollen production is controlled by duration of flowering, mechanisms of liberation and dispersal, pollen size, time of release, and other physiological factors. For example, higher rates of *Ailanthus excelsa* occurred from 4 pm to 10 am with a peak at 6 pm that coincides with the activity of honeybees (*Apis cerana indica*). In comparison, *Cyperus rotundus* releases pollen from 4 – 6 am with a peak at 5 am, but its pollen may remain in the atmosphere for many hours.

Chapter 12 is devoted to melissopalynology (the study of pollen in honey) and is especially interesting. Attention is given to how honey is made, what makes honey an energy and nutritious food source, quantity and quality of pollen for maximum honey production, determining geographical origin of honey samples, and pollination management strategies. The shortage of honeybees to pollinate essential agricultural crops (almonds, strawberries, blueberries), throughout the United States and why honey is a regarded as a medicinal food also are discussed. For example, the authors note that honey contains over 25 assorted sugars each one having a different function in human metabolism as well as an abundance of amino acids, and enzymes. They cite authorities who have claimed medicinal properties for honey, such as to promote healing, slow down cell aging, and alleviating menstrual pain.

This book will be useful to upper division undergraduate, graduate and post-doctorate students and research scientists who want to gain an understanding of applied palynology, as well as for educators. For example, I intend to explain and utilize some of the gravitational sampling devices discussed in this book in forthcoming environmental

science classes, and will likely utilize some of the described techniques in my research. Excellent drawings, tables and maps are provided throughout these chapters. Color and SEM photographs also are used to show pollen morphology and plant features of *Ambrosia* (ragweed) an invasive plant from North America that is becoming a nuisance in Europe. This book is not without flaws; for example, there are a few misspelled words throughout the book, as well as taxonomic errors. For example, on page 89 *Anthoceros* (a hornwort) is misidentified as a liverwort. Some of the references cited in the book are rather dated (prior to 1960), although references within the last five years are also provided. Overall, this is a book I would recommend.

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**Seedling Ecology and Evolution.** Leck, MaryAllessio, V. Thomas Parker and Robert L. Simpson (eds) 2008. ISBN 97-0-521-69466-7 (Paper US\$70.00) 514 pp. Cambridge University Press, 32 Avenue of the Americas, New York, NY 10013.

For most humans, baby animals elicit warm feelings and happiness, even when their parents are quite ferocious, scary, or ugly. Baby plants don't usually cause the same responses; more often, we are amazed at how different they look from the adult plant, and the difference in size between the seed, seedling, and the adult. Many botanists and gardeners who cultivate plants from their seeds feel some excitement when the seeds germinate, and pleasure when the seedlings grow into juvenile plants, but we are admittedly a select group. Most people, however, rely on plants making it through the seedling stage to grow and provide whatever crop, product, study object, or ecosystem service is expected; all of us, therefore, will find much of interest in this excellent book.

The three editors of this multi-authored volume, all expert in wetlands and a variety of other topics, contribute chapters themselves that introduce and tie together the many other contributed chapters. Starting with the more autecological aspects of seedling biology, then establishing the morphological, taxonomic, and physiological foundations, the chapters build to many considerations of ecology at the population and community levels. The last part of the book has several chapters dealing with applications, invasions, disturbances, and restorations.

Seedlings are small and vulnerable, and influenced by many factors that affect their establishment and growth. The introductory chapter gives us a short seedling primer, where the parts and their functions of the typical seedling types are outlined. The editors/authors also point out that seedlings are but one part of the plant life cycle, but essential to the continuity of the species. They introduce the concepts of filters and safe sites, topics elaborated by other authors later in the book.

The natural history of seedlings (Leck and Outred) sets the stage for subsequent chapters on seedlings in stressful environments and specialized seedling strategies. The latter chapter (by Whigham et al.) explores some very interesting groups of seedling plants (including orchids, parasites, carnivorous plants). Mostly a review of published works, there is a temperate bias.

The next section begins with a fascinating chapter on embryo morphology and seedling evolution, in which Niklas considers all seed plant groups and their spore-producing forebears (all embryophytes, or land plants). Cotyledons went from absorptive to storage organs. There was a trend from exoscopic to endoscopic embryogeny, with bryophytes, sphenophytes, and some ferns having exoscopic embryogeny, other ferns, all leptosporangiate ferns, and seed plants having endoscopic embryogeny. Farnsworth provides insight into the influences of phytohormones on seedlings; Kitajima and Myers consider the ecophysiology of seedlings, considering patterns associated with opportunistic vs. conservative carbon allocation strategies. They point out that phenotypic plasticity is under genetic control, and that seedlings of 'gap' species show more plasticity than seedlings of late successional species. Horton and van de Heijden examine the role of symbioses in seedling establishment and survival, especially mycorrhizal fungi. This chapter has some very nice figures with photos of both kinds of mycorrhizae, in nicely labeled diagrams.

The next section of the book (Life History Implications) begins with a chapter by Moles and Leishman in which strategies and trade-offs are reviewed. My two favorite chapters of the book are in this section (my ecological bias).

In the first of these, Eriksson and Ehrlén discuss seedling recruitment and population ecology, reminding us that "a stable population is maintained if one reproductive individual is replaced, on average, by one successfully recruited offspring". With this in mind, life span should correlate with the rate of seedling recruitment; short-lived plants should have greater recruitment rates than longer-lived ones. They consider various causes of mortality:

herbivores, pathogens, drought, and competition. They weigh the importance of microsite (safe site) limitation versus seed limitation.

The next chapter (by Keeley and van Mantgem) focuses on seedling communities, in the modern light of community assembly rules (restrictions based on the presence/abundance of other species, not simply species-specific responses to the environment). The null model, that taxa assort at random, is not valid if there are significant environmental filters (such as soil type variation, low phosphorous content, fire, distance from coast) that lead to non-random combinations of recruitment patterns. In another chapter, Kollmann considers functional groups in spatial variation in seedling emergence and establishment.

The last contributed section examines applications in invasion biology, anthropogenic habitat degradation, and restoration ecology. Hyatt writes that seedling ecology may not be too important in invasive species, but these invasive species may have negative effects on native seedlings. Baken considers seedlings in restoration of dryland systems, and Dalling and Burslem discuss seedling responses to human disturbance in tropical forests. Galatowitsch considers the pros and cons of using juvenile versus adult stock in ecosystem restoration. Creating safe sites to promote seedling establishment is a key to success, keeping in mind interactions with microbes and herbivores.

The final chapter by the editors puts the seedling into an ecological and evolutionary context, tying it all up nicely. The extensive references (108 pages!) serve to aid readers in following up on topics of interest, and the index is very useful as well, with taxa, concepts, and catchwords for locating items encountered but mislaid.

It is inevitable in an edited, multi-authored work that there is some redundancy of topics. But overall, this is an appealing, interesting, and useful book. My graduate students and I have all found information of use in our various research projects, and I have learned some new things to enhance my teaching in Plant Ecology next spring, both lecture and lab class activities. I recommend this book enthusiastically and predict it will be well received by both general and specialized audiences.

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