



Review: Soil Seed Banks

Reviewed Work(s):

Ecology of Soil Seed Banks by Mary A. Leck; V. Thomas Parker; Robert L. Simpson
Susan Kalisz

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MEASURING ABOVE-GROUND VEGETATION

Bonham, Charles D. 1989. **Measurements for terrestrial vegetation**. John Wiley and Sons, New York. x + 338 p. \$49.95, ISBN: 0-471-04880-1.

Measuring vegetation can be a daunting task. Component species often differ greatly in their morphology, defying application of consistent methods. Whole plants (or their parts) are awkward things to measure, and spatial and temporal heterogeneity typically are great. The ecologist rarely has the opportunity to bring the objects of study indoors, and must contend with constraints imposed by irregular terrain, variable lighting, and unpredictable weather. Frequently, limited time and the need to cover large territories must be reconciled with the desire for reasonable levels of precision and accuracy. An additional problem is the existence of an array of available methods, each with advantages and disadvantages. Faced with these difficulties, a researcher contemplating measurement of vegetation would benefit from assistance in selecting measurement strategies. *Measurements for terrestrial vegetation* will be useful in this respect.

The author begins with two introductory chapters designed to provide an overview of the subject. The third chapter covers some general statistical concepts relevant to measurement problems. The following three chapters, which constitute about half of the book, focus on four commonly employed measures of vegetation: frequency, cover, density, and biomass. Frequency and cover are discussed in a single chapter, while density and biomass are assigned a chapter each. A concluding chapter considers the use of various measurements in monitoring vegetation change.

The preliminary chapters are disappointing. Consistent usage of terminology that one expects from a book of this nature is lacking. The term "unit" appears in so many different contexts as to become almost meaningless; Bonham variously uses the term to refer to a member of a population, a piece of equipment, a unit of measurement in the usual sense (grams, metres), and so on. The second chapter, entitled "Units for measurements," is thus an overview of the many types of equipment used in vegetation measurement. Other problems emerge in the early chapters. A table in the first chapter outlines "metric weights and measures," but there is no mention in the book of the International System of Units (SI), and no guidance offered for style or usage; the editors of *Ecology* would no doubt frown on Bonham's use of *weight* instead of the preferred *mass*. In other places, the author fails to develop his subject in a clear, logical manner. An example is the presentation, on pp. 66–67, of a method for determining sample

adequacy. A single letter variable, *k*, is assigned two very different meanings in this section, and an unfortunate substitution of the word "less" for "more" further muddies the presentation. Some alternative methods for determining sample adequacy are not mentioned in this part of the book, but appear instead more than 100 pages later, at the end of the chapter on density measurements.

The latter chapters provide better reading. Bonham carefully presents the principles behind various techniques for obtaining a particular kind of measurement, such as plant density. Assumptions, potentials for bias, and estimates of variance are presented when appropriate. Practical considerations, including design and use of equipment, are covered, as are approaches to maximizing the benefits of precision and accuracy against the costs of time and effort. The coverage of topics seems reasonably complete, and frequent citations guide the reader to additional detail in the original literature.

A variety of general problems with style and approach to presentation mar the volume. The author has a penchant for adverbial conjunctions, which becomes annoying. The line drawings are rather crudely done, and should have been replaced by more refined drawings or photographs. Typographic errors are rare, however, and the book benefits from an ample index. The concluding chapter on the use of vegetation measurements in monitoring is interesting, although other applications of data (in analysis of vegetation-environment relationships, for example) could have been covered.

This book would be more appropriately entitled *Above-ground measurements for terrestrial vegetation*. Bonham barely acknowledges the fact that most plants have roots, and that ecologists have spent a great deal of time and effort devising ways to measure roots. For insight into the methods and voluminous literature on root measurements, one must turn to W. Böhm's 1979 *Methods of studying root systems* (Springer-Verlag, New York. 188 p.).

Measurements for terrestrial vegetation represents a mostly positive step toward bringing a complex and difficult subject together in one publication. Ecologists would do well to consult this book when planning research involving above-ground vegetation measurements. Due to the limitations discussed above, other sources will no doubt have to be consulted in developing a final sampling and measurement plan.

THOMAS R. WENTWORTH

NORTH CAROLINA STATE UNIVERSITY
 Department of Botany
 Box 7612
 Raleigh, North Carolina 27695-7612

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SOIL SEED BANKS

Leck, Mary A., V. Thomas Parker, and Robert L. Simpson (eds.). 1989. **Ecology of soil seed banks**. Academic Press, San Diego, California. xxii + 462 p. \$69.95, ISBN: 0-12-440405-7.

Anyone who has weeded a garden has had first-hand experience with plants emerging from soil seed banks. The quantities of seeds in soil seed banks in many natural and agricultural plant communities can reach astonishing numbers

(> 7×10^5 seeds/m²). Obviously, these dormant seed populations can be expected to have significant ecological and evolutionary influences on plant population and community dynamics. Despite a long-standing knowledge of the existence of soil seed banks, descriptions in the literature of their occurrences and species compositions are relatively recent. *Ecology of soil seed banks* represents an important effort by the editors (Leck, Parker and Simpson) and 22 additional contributors to synthesize and interpret this diverse literature. This book will be of interest to a wide array of scientists. Graduate students or others new to this area will find a wealth of well-organized, well-presented information and an extensive collection of references.

The goals of this book are 1) to address the factors which affect seed bank dynamics, 2) to determine general patterns in the seed banks of different species and 3) to view these patterns from the perspective of community ecology. The volume has five parts: Introduction, Processes, Seed Banks and Vegetation Types, Management, and Synthesis. The Foreword (Grime) describes a typology of soil seed banks. This typology appears to be the basis of the unusually broad definition of a seed bank used in the book: all post-dispersal viable seed in the soil or associated litter. The Introduction provides background information, natural history (Baker), and general research questions. The editors make important pleas for the standardization of sampling methods on temporal and spatial scales, and for an understanding of the germination requirements and population biology of the species of interest.

Three chapters are included in the section entitled Seed Bank Processes. Louda thoroughly and thoughtfully reviews the empirical work on seed predation. She points to many gaps in our understanding of the role of predation in recruitment dynamics and to opportunities for future research. Baskin and Baskin draw on their extensive empirical data base to classify five types of seed dormancy, with their associated causes and characteristics. They provide numerous examples of the germination patterns of species possessing different dormancy types. In the third chapter Venable reviews models of the evolution of within-year germination patterns, persistent seed banks, and the role of the seed bank in the evolution of complex traits. He cogently explains the utility of modelling both the evolution of seed banks and the effects of seed banks on evolutionary rates. I found it unfortunate that more space is not devoted to this Processes section. Missing are treatments of the biochemical control of dormancy and germination, a review of the data on the genetic basis of seed germination/dormancy, and a synthesis of the few studies of seed bank demography.

The largest section of the book addresses Seed Banks and Vegetation Types. The environmental factors which favor the existence of a seed bank and detailed syntheses of available data are presented for eight ecosystems ranging from the Arctic to the Tropics. The cohesive theme in all of these chapters is the role of persistent seed banks as an adaptation to disturbance and/or environmental unpredictability. The chapters in this section summarize a wealth of data in addition to

interpreting emergent patterns within the communities. Special attention is given to the relationships of seed banks to life history (McGraw and Vavrek), seed size (Pickett and McDonnell), successional stage (Pickett and McDonnell; Garwood), recovery (Archibold; Leck), spatial and temporal variation (Garwood; Kemp) and seed age or age-structure (Rice; Parker and Kelly). A section on Management follows, on the control of population size of agricultural weeds (Cavers and Benoit), the preservation and conservation of threatened populations or communities (Keddy, Wisheu, Shipley and Gaudet), and the balancing act of restoring native species while keeping invasive non-natives in check (van der Valk and Pederson). The volume closes with an editorial synthesis emphasizing the general importance of soil seed banks in population and community stability, dynamics, and resilience, and giving suggestions for future research efforts.

This book presents a firm foundation of community-level seed bank patterns which prepares the way for future research efforts. Experimental studies that complement seed bank species descriptions are clearly needed to understand the mechanisms and processes which select for persistent seed banks. There are repeated calls for a more reductionist look at the population-level processes. Basic knowledge of transient or persistent seed bank formation are lacking for most species. "More natural experiments" than the seed burial experiments conducted by early researchers interested in seed longevity are called for (Baker). In addition to these points, I would also suggest that attention be paid to other aspects of soil seed banks. Quantification of the proportions of seeds entering into, remaining within, and emerging from soil seed banks, as well as the ecological factors influencing these proportions for individual species are fundamental to our understanding of soil seed bank dynamics. These data remain a missing link in the understanding of the influence of persistent seed banks on plant demography.

Two aspects of the genetics of seed banks are central to our understanding of seed banks in evolutionary ecology and await empirical investigation. First, understanding the genetic control of dormancy/germination in natural plant populations coupled with artificial selection experiments on the degree of dormancy will allow us to interpret ecological seed bank patterns considered adaptive. In addition, the extent to which seed banks store genetic variability remains a question of interest to ecological geneticists, evolutionary biologists, and conservation biologists. This volume provides ample background and inspiration for new arenas of research in soil seed banks. The perspectives developed will be important to researchers interested not only in seed banks but in any population or system in which a portion of the life cycle is spent as a dormant egg, spore, or other resting stage.

SUSAN KALISZ

MICHIGAN STATE UNIVERSITY
W. K. Kellogg Biological Station
Department of Botany and Plant Pathology
Hickory Corners, Michigan 48060