

ECOLOGICAL SCALE Theory and Applications

By D. L. Peterson and V. Thomas Parker, editors

A book review by Allan F. O'Connell, Jr.

Much of how we care for and manage our natural world this century will revolve around how ecological scale is interpreted. The question of scale—the range of specificity applied in natural resource studies and management—is fundamental and critical for ecologists. Yet application of scale concepts is a complex and contentious area of ecology that is often difficult for resource managers to implement in planning and conservation efforts. Given the enormous amount of material currently available and the difficulty scientists and resource managers face in simply finding all available literature on a particular topic, “Ecological Scale—Theory and Applications” represents an important compilation of information under one cover. For a topic described as “important, poorly understood, and controversial” (another review of this book), this publication should be a mainstay for scientists and resource managers everywhere in need of a thorough and first-rate reference on ecology.

Part of the “Complexity in Ecological Systems” series, *Ecological Scale* is divided into four sections: (1) integration of process, pattern, and scale; (2) interpretation of multiple scales in ecosystems; (3) ecological inference and application—moving across multiple scales; and (4) incorporating scale concepts in ecological application. The entire volume is 608 pages, with 33 different contributors (some authors participated in more than one chapter) and 72 pages of references. The book is truly interdisciplinary, and the editors have clarified and illuminated the importance of scale in a variety of ecosystem components: animals (including an entire chapter on large mobile organisms), plants, water, food webs, and soils. Additional highlights include scale-oriented reviews of ecological theory,

ecosystem management, relationships to policy and decision making, experimental design, and measuring environmental change.

A previous book review in *Park Science* stated “many books on conservation topics have poorly integrated chapters, are hard to read, are often dull, and end up serving primarily as references for a narrow, technical audience” (see volume 18(1):10–12). Some of these assertions may apply to *Ecological Scale*; browsing the chapters reveals a good deal of complexity in consideration of the many tables, figures, and citations. I had some trouble maintaining focus and interest in some chapters but attribute this to my own particular interests. Nonetheless, given the diversity of topics covered, I found the

volume to contain a wealth of important information on how ecologists and resource managers view ecosystems and their various components. Additionally, the book delves into the application of the concepts of measurement, analysis, and inference in both theoretical and applied ecology, essential information for park resource managers.

With some humorous, but thought-provoking chapter titles that include “Homage to St. Michael or why are there so many books on scale,” the importance of scale in biological systems quickly becomes evident. With the interest of the resource manager in mind, I have attempted to summarize each of the four sections, point out some highlights, and offer a few parting comments.

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Ecological Scale— Theory and Applications

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608 pages

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\$35.00

Section I—

Integration of Process, Pattern, and Scale

The book begins with the aforementioned “Homage to St. Michael...” chapter that discusses the semantics and implications of the terms “scale” and “level” in ecology. This section provides a detailed review of techniques used for detecting spatial patterns including a concise definition of fractals and the need to understand process and pattern as they relate to experimental design. A discussion ensues using landscapes as a backdrop and concluding that the integration and organization of scaled relationships within complex systems will clarify our understanding of the natural world. Some things are scale dependent, others are not, and the differences are pointed out. The last chapter of section I examines the ambiguity that surrounds the concept of habitat and the evolving concept of niche. The Habitat-Based Model is used to describe these relationships and the model’s operational framework is presented.

Section II—

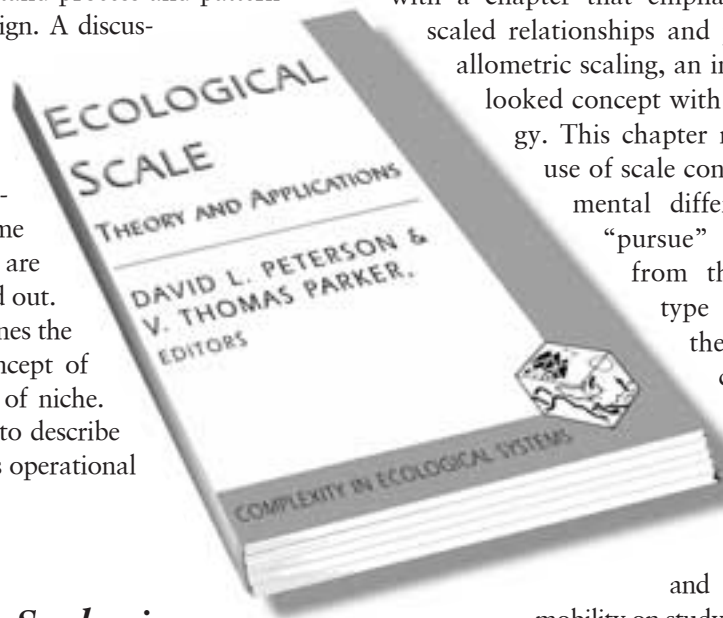
Interpreting Multiple Scales in Ecological Systems

A paleoecological perspective compares hypothesis testing versus the description of microscopic plant pollen (fossil) that is the primary source of information about environmental change. The question “How can techniques be used for management applications?” is examined. The discussion then focuses on soils and their resulting spatial and temporal relationships. Criticism is levied on the views ecologists have long held for soil, and the major misperceptions of the soil environment are addressed. The physical environment and biological structure of lakes and riverine systems are reviewed along with the importance of human influences on these systems. The next chapter considers how to examine scale issues in the context of plant community dynamics and the usefulness of hierarchy theory and predictive model development. A well-crafted chapter on animal population dynamics completes the variety of single-system components that are examined, and will likely stimulate integrated work on animal populations in the context of dispersal and landscape structure. The last two chapters focus on food webs (i.e., species richness, trophic or nutritional levels) and landscapes, two topics representative of integrating the components previously discussed.

Section III—

Moving Across Scales: Ecological Inference and Applications

Based on the variety of topics, this section has little continuity, much like the following review. Nevertheless, the topics are important and offer insights into the study and management of large organisms and the use of applied scaling theory to conduct research. The section begins with a chapter that emphasizes the importance of scaled relationships and provides an overview of allometric scaling, an important and often overlooked concept with respect to scale in biology. This chapter notes that the increasing use of scale concepts represents a fundamental difference in how scientists “pursue” research, a move away from the purely observational type of research pervasive in the 20th century. The difficulty with remote sensing and the use of large data sets is complicated by the differences in the meaning of scale to geographers and ecologists. The impact of mobility on study design and interpretation with respect to how animals interact with the environment is directly related to scale. The break point for what is considered a large organism was not defined, but one gets the impression that extrapolation could be made to any size organism. The importance of trees, in particular tree branches, in determining patterns of vegetative change is offered as the scale from which to focus ecological research. The authors give a variety of reasons in support of this approach as opposed to either the leaf- or the entire tree-focused approach. The next three chapters are key for scientists and resource managers alike, given the importance of ecosystem disturbance, study design, and data analysis in conducting and interpreting research. While the discussion surrounding these three topics is overwhelming, the topics themselves are of critical importance if we are to critically examine and understand our resources. Although some topics like time series and autocorrelation are more suited for the scientist, the resource manager striving to keep abreast of the intricacies of the science in their parks would do well to review these chapters.



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Section IV—

Incorporating Scale Concepts in Ecological Applications

This section describes how managers and scientists can effectively apply concepts of scale to natural resource management. Flow chart (i.e., word) models, tables, and diagrams effectively support the text and illuminate how we use scale to measure environmental change and how scale affects research, management, and most importantly policy. Discussion of policy issues include air pollution and salmon in the Pacific Northwest, fire, and global climate change, each demonstrating a perspective that all resource managers should consider.

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Conclusion

Covering the complexity of the scale topic, this volume represents an important compilation of information on a topic that is often misunderstood, and one for which little attention is paid (although, thankfully, this seems to be on the decline). Although technical, this book provides full exposure to the scale issue in ecology and is an important reference for researchers and resource managers who are working to understand and preserve ecological function in parks. The authors and editors have combined to provide a needed examination of a very important topic. In summary, why purchase all those books on scale when just one will do? The mountain of information alone stuffed into this one book should prompt all parks to get a copy and have it on hand as a quick and ready reference. **P**

About the Author

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