

J. Wu, K. B. Jones, H. Li and O. L. Loucks, Scaling and uncertainty analysis in Ecology. Methods and Applications

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During September 2002, a workshop was held entitled “Scaling and Uncertainty Analysis in Ecology: Methods and Application” from which this book emerged.

The objectives of this synthetic and practical book are to introduce the basic concepts, principles and methods of scaling theories and the uncertainty and error propagation on landscape ecology. The aim is to provide suggestions for how landscape ecologists may conduct research relevant to management considering scaling and reducing uncertainty in field assessment, and to offer useful information and ‘rules of thumb’ to help guide natural resource managers.

The book is an interesting and eminently comprehensible manuscript with separate, individually complete and very comprehensible, chapters organized on three parts. The first part presents a very extensive but complete and informative roundup on concepts and methods of scaling and its importance whenever information is averaged over space or time. This theoretical part explain why and how ecological research, aiming to predict or understand processes, should put scaling into action introducing several specific

scaling operations and clarifying concepts and methods to use. A second aspect, highlighted in this first part, is uncertainty when conducting scaling in ecological studies. Sources of uncertainty are addressed and reviewed challenging ecologist and managers to conduct scaling methods with known unavoidable uncertainty. Mostly focused on modelling, uncertainty is presented as error propagation from model parameters or input data to model outputs or scaling results.

The second Part of this book is a collection of case studies of scaling and uncertainty analysis conducted on different landscape ecosystems. The series of applications illustrate how the problem of scale multiplicity in ecological patterns and processes are handled. Focus is made on the need of conducting field observations over a range of environmental conditions to make model estimates more accurate. These ranges could determine the upper and lower boundaries for each component measurement and by propagating these estimates (e.g. using the Monte Carlo models) almost all modeled ecological processes would be covered.

Two remarkable chapters (11 and 12) deal with nutrient export as a function of landscape characteristics and the associated uncertainty on its parameterization. In this work, Jones et al. using the regression tree analysis identified the set of scaling structures derived from the complete set of sampled variables. The outcome is a better

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understanding on how changes in environmental variables, function of different biophysical scenarios, are critical in firstly identify the spatial and temporal heterogeneity and then determining environmental characteristics and management needs. In this case, scaling functions can be used as environmental indicators giving this way a hierarchical view of the processes occurring on the system. The modeling of this nutrient export explained by Wickham et al. give us a valuable example on the importance of the uncertainty associated to scaling functions and modeling parameterization. The impact of such uncertainty to environmental management issues is highlighted, primarily for cases where the interdependences between ecological and physical processes change in differential scales.

Throughout this second part, studied systems are diverse and generally reflect the broad application of landscape ecology. This is very refreshing. Numerous chapters investigate the application of scaling principles to aquatic and riparian systems, and highlight the logical extension of landscape ecology to water and coastal management. There are also a number of methods discussed, which optimize sampling effort across scales, investigate approaches to field sampling of large heterogeneous landscapes, and describe remote sensing applications. The use of models in testing hypotheses of landscape change and carrying out broad-scale ‘experiments’ to evaluate management scenarios is also discussed. Although and because “Predictions without accuracy information are of little value” the real innovative focus of this section and this book in general is the consideration of uncertainty analysis as a required and complementary tool when scaling or modeling. One can encounter some methods of uncertainty analysis and respective case study clarified for model error propagation (Chapter 3 and 12), occupancy models biases (Chapter 5 and 14), landscape complexity and extrapolation errors (Chapter 7, 11, 13 and 16) and remote sensing (Chapter 8 and 15). This

complementarity between the theoretical and applied parts of the book clearly put in evidence the editors reflection for the book as a whole and cohesive work and not simply an assemblage of theories and case studies combined without a real junction between them.

The editors finish by a good synthesis of all the scaling and uncertainty analysis presented throughout the book. This final part recapitulates the main findings of the book with a remembering table of the main objectives, system properties, scale domain and scaling issues treated in each chapter, certainly a must reference for all future works on scaling with known uncertainty and not only for landscape ecology researches.

In fact, although the emphasis is in landscape ecology, since landscapes are heterogeneous and often hierarchically structured, theories and some of the case studies presented in the book could be of effective help to all ecological and environmental research.

A web site dedicated specifically for this book is freely accessed at: <http://leml.asu.edu/ScalingBook/> where one can find the abstract of each chapter, some links for additional information on scaling and uncertainty analysis and the colored figures which were converted to grayscale when editing the book.

One can simply regret that this book appears as a pan-American research and case studies; although this could be explained since the workshop and researches from, which this book emerged, were supported by US funding programs. It is also deplorable that editors overlooked some theories or cases such as the adaptive management where scaling models, strategies and policies are modified through time as knowledge increases and uncertainty decreases.

These criticisms do not, however, detract seriously from a book which should be on the desk of all those directly concerned not only with landscape ecology but also for all researchers dealing with scaling in ecology and management.