

Book Review

Models in Ecosystem Science

C.D. Canham, J.J. Cole, and W.K. Lauenroth (eds.). *Models in Ecosystem Science*. Princeton University Press, Princeton, New Jersey, USA. 2004, 476 pp. illus., 24 cm. Hardcover, ISBN 0-691-09288-5, US\$85.00. Paperback, ISBN 0-691-09289-3, US\$37.00.

Of all the disciplines within ecology, landscape ecology is arguably most dependent upon models and modeling due to the inherent limitations of space and time found at the landscape scale. Relative to landscape ecology, ecosystem ecology has a longer, more varied experience developing and using models. The strength and depth of these experiences is reflected in the biennial Cary Conference, held at the Institute of Ecosystem Studies, in Millbrook, NY. *Models in Ecosystem Science* is a product of the ninth Cary Conference, convened in 2001. So what can landscape ecologists learn from the experiences of ecosystem ecologists about the development and use of models?

As it turns out, we have a great deal to learn from ecosystem ecologists. First, many of their experiences have directly evolved into landscape modeling, providing a direct connection between our disciplines. These connections are readily apparent from the participants represented here and the diversity of modeling approaches. In this respect, we can learn about our past and the context from which landscape models have evolved. Second, ecosystem ecologists have invested heavily in an examination of the epistemology, the strengths and limitations, and the future of modeling in ecology. It is this perspective that gives *Models in Ecosystem Science* the scope and vision that make it a great and timeless contribution not just to ecosystem and landscape ecology, but to anyone in any discipline that develops or uses models.

Models in Ecosystem Science is divided into five fairly coherent sections addressing models in ecosystem science, model evaluation, environmental policy and management, the future of modeling, and a concluding remarks section. Some sections

begin with broad overview chapters that set the tone and provide context for subsequent chapters. The chapters are all generally well written and follow the themes outlined for each section.

Three chapters in particular serve as hallmarks of excellence in describing models, the modeling process, and the challenges and limitations to using model results. The introductory chapter by the editors is essential reading for any modeler and has particular relevance to landscape ecologists. Their overview provides a superb summary of the book and of the role of models in ecology and would serve as an excellent introduction to models for graduate students. Naomi Oreskes (chapter 2) provides critical insight into the compromises among uncertainty, prediction, and complexity. Her chapter is a must read for any modeler in any discipline. Roger A. Pielke, Jr. (chapter 7) examines the use of predictive models in decision making and the communication of model results to decision makers. Such analysis is increasingly important as landscape modeling evolves from simple neutral models to complex and precise models with policy implications.

In addition, there are many excellent chapters relevant to landscape ecologists, including chapters that address propagation and analysis of uncertainty (chapter 8); Bayesian modeling approaches (chapter 9); model validation and testing (chapter 10); the utility of inter-model comparisons (chapter 12); and the limits to models in ecology (chapter 24). Together, these eight chapters justify a recommendation of this volume to landscape ecologists.

Not every chapter has immediate relevance to landscape ecologists. They are either too narrowly written or simply outside the bounds of our discipline. Other chapters summarize discussions held at the Cary Conference and are somewhat underdeveloped. However, given the long tradition of Cary Conferences, we can be optimistic that these discussions will serve as a spring board for further, more in-depth explorations.

Landscape ecologists are also underserved by the section on environmental policy and management. As landscape ecology often lies at the juncture between science and management, a stronger, more coherent discussion of the risks and opportunities of model application for management would have been a welcome addition. In particular, the emerging consensus on the use or misuse of scenarios to inform science, management, and policy is given scant attention. Aside from Pielke's earlier chapter, Harold Bugmann's chapter (*Predicting the Ecosystem Effects of Climate Change*) comes closest to directly confronting the challenges for modelers who engage managers and policy makers.

Models in Ecosystem Science does not attempt a comprehensive survey of ecosystem modeling. For landscape ecologists, many critical elements

of modeling (e.g., disturbances, large-scales, scaling relationships) are overlooked or absent. Nevertheless, this volume provides an excellent summary of many current perspectives in ecological modeling and makes a significant contribution to our understanding of how models are developed and applied. Although its greatest value may be to landscape modelers, given the centrality of modeling to landscape ecology, it would be a valuable addition to all of our libraries.

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