

The next big challenge I see for museums is to make dioramas of insects that truly show their incredibly detailed morphology. The simplistic ones at the American Museum and the Field Museum show only caricatures of insects, lacking all their wondrous detail. I am waiting for an exhibit based on scanning electron microscopes that will show insects as they really are. The current crop of nature videos appears to be attempting to make all Americans hate and fear insects. Kohler claims that “tiny insects and invertebrates lack the human appeal” that led to dioramas and collecting expeditions, but that is the fault of our education, not the fault of the insects, which are much more spectacular than most birds. People cannot relate to creatures they can hardly see. Correct scientific depictions of insects could help recruit the army of new taxonomists needed to tackle the millions of incredible insects in the rainforests.

The illustrations in *All Creatures* are mostly photographs of people who did the collecting. I was disappointed that there were no illustrations of the field data sheets used to record information, and no photographs of the equipment used during the expeditions. There are few good photographs of people actually working, although there is a wonderful shot of Francis Sumner with his half-car, half-truck, taken in 1920 in the Panamint Mountains of California. In spite of “accurate” records, in one photograph the burro “Pardo” is identified but the collector is only “possibly” J. H. Barry, collecting for the American Museum in Mexico. Another unknown collector is shown with more than 60 skins drying in the Mexican sun in 1904. It is clear that the all-important specimens are well labeled, but the photographs of people are not. Of the four men examining the Rothschild bird collection being unpacked in February 1935 at the American Museum, only Ernst Mayr is identified.

Few women are shown, not even Annie Alexander, one of the founders and a patron of the Museum of Vertebrate Zoology at Berkeley. There is a wonderful shot of Edith Clements repairing the field vehicle while the men are off collecting, however. Women played a small but im-

portant role in many of the early expeditions, in striking contrast to circumstances today, when women make up about half of field researchers and collectors.

I am much impressed with Kohler’s knowledge and appreciation of taxonomists and how they work. As he points out, taxonomy has been a second-class biological occupation, usually dismissed as unimportant and second-rate by experimental biologists. I am an ecologist-behaviorist who has been forced to do taxonomy on flies and mites because I could find no one to study my collections. My brief exposure to taxonomy convinced me that it is amazingly difficult. Even big animals such as giraffes are still causing taxonomic dispute. I applaud Kohler for his sympathy for the taxonomists, who do not often get much credit.

Although *All Creatures* supposedly ends at 1950, it mentions E. O. Wilson’s 1980 plea for a complete inventory of world species. Kohler questions why we “spend billions exploring extraplanetary space but balk at the cost of exploring our own earthly environment.” I think this is another manifestation of how the military-industrial complex rules our world. The world for the taxonomist is not likely to change until insects become weapons of mass destruction.

Taxonomists who feel depressed about their lack of recognition should read this book. Experimental biologists who believe in the superiority of their own approach should also read it to learn that the whole field of evolutionary biology is supported at the roots by the taxonomists.

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## MEASUREMENT, SCALE, AND PREDICTION: CAVEAT EMPTOR

**Scaling and Uncertainty Analysis in Ecology.** Jianguo Wu, K. Bruce Jones, Harbin Li, and Orië L. Loucks. Springer, Dordrecht, The Netherlands, 2006. 351 pp., illus. \$119.00 (ISBN 9781402046629 cloth).

To understand, manage, and assess the effects of change on the Earth’s ecosystems requires a troika of measurement, translation, and prediction of patterns with changes in scale. This problem is familiar to ecologists: Pielou (1969) discussed issues of spatial sampling and data analysis nearly 40 years ago; O’Neill (1979) explored the transmutation of information across levels of complexity; Allen and Starr (1982) provided new perspectives from hierarchy theory; and Levin (1992) galvanized interest with his 1989 Robert H. MacArthur Award Lecture to the Ecological Society of America. The unresolved issues revolve around the complex response of ecosystems to change; the insufficiency of measurements in time and space; and the diversity of approaches now being employed by geographers, geologists, atmospheric scientists, and ecologists.

*Scaling and Uncertainty Analysis in Ecology*, an edited volume resulting from a workshop specifically designed to address these issues, has been ably produced by Jianguo Wu, Bruce Jones, Harbin Li, and Orië Loucks. These four editors have a broad range of backgrounds and experience in the relevant theory and practice. Their stated goals were to review and make sense of the many approaches to scale transformation and prediction; to address the effects of uncertainties on this process; and to provide a synthesis useful for management, planning, and decisionmaking. The text achieves the first two objectives with a thorough review and careful definition of terms, but the final objective—to make theory and methods useful and accessible to a broad audience—remains tantalizingly out of reach.

The 18 chapters of this book are arranged into three sections. The first section reviews concepts and defines terms. Chapters 1 and 2, by Wu and Li, are well-constructed overviews with clear expositions of issues concerning extrapolation across scale. Those unfamiliar with this subject will appreciate these chapters and the perspective they provide. The third chapter, also by Li and Wu, reviews the history and methods employed in the analysis of uncertainties of model predictions. There has been a recent resurgence of interest in uncertainty analysis, making this review timely and useful. Because complex systems often have many variables with high uncertainties, this chapter leaves the reader with the pessimistic view that reliable predictions may be beyond current capabilities. In fact, a central point of earlier work revolved around the fact that only a few variables are usually responsible for most of the uncertainties associated with predictions. The importance of this result is that it focuses future studies on measuring specific processes that will most increase our confidence in predictions. This feedback between prediction and measurement should be an organic component of all ecological studies.

The remaining chapters of this section provide a diverse set of approaches to scale-dependent analysis and prediction. The discussion of multilevel statistical models by Richard A. Berk and Jan de Leeuw provides access to these methods for the ecological community; the contrasting requirements of nonspatial, spatially implicit, and spatially explicit methods, reviewed by Debra P. C. Peters and colleagues, are fundamental to the problems of spatial prediction; and the discussion of landscape prediction by Carol A. Wessman and C. Ann Bateson succinctly summarizes all spatial extrapolations by stating that “heterogeneity and non-linearity are the two factors determining the magnitude of scaling errors and bias.”

The second section of the book presents a series of case studies. As in most edited volumes, there is much of interest here, but it is difficult to extract governing principles or unifying themes that

will resolve the problems of measurement, scale, and prediction. There are four chapters on nutrient dynamics, each with different scale-dependent perspectives; two chapters on avian habitat issues; two chapters on landscape analysis; and a single chapter on policy issues associated with water quality. Undoubtedly the reader will find these examples interesting, but will be forced to parse and select among the different approaches. Because the stated goal of this volume was “to provide a synthesis useful for management, planning and decision making,” it would have been helpful to provide at the start of each chapter a bulleted list of topics considered, methods employed, and principles explained. A nice overall chapter outline is provided late in the text (table 18.1, p. 332), but this summary is limited to an indexed list of keywords that does not exhaustively cover the concepts and applications essential for planning and management.

The final section comprises a single synthesis chapter written by the four editors. This chapter emphasizes the importance of scale and uncertainty for prediction. Although most of the discussion consists of caveats and warnings, a systematic and pluralistic philosophy is outlined. The final conclusions provide a useful summary, echoing observations found early in the text:

In general, only when the scales of observation and analysis are properly chosen, may the characteristic scale of the phenomenon of interest be detected correctly; only when the scales of experiments and models are appropriate, may the results of experiments and models be relevant; only when the scale of implementation of policies is commensurate with the intrinsic scale of the problem under consideration, may the policies be effective. (p. 7)

*Scaling and Uncertainty Analysis in Ecology* is an expensive book to add to a personal library—the cloth edition costs more than \$100, and the paperback about \$50. Nevertheless, it may be a wise purchase for those seeking a coherent introduction to the issues of scale, mea-

surement, and prediction. I am pleased to have a copy on my shelf, and I plan on referring to it often for its exposition of concepts and for the diversity of examples presented.

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## ONE STEP AT A TIME

**Amniote Paleobiology: Perspectives on the Evolution of Mammals, Birds, and Reptiles.** Matthew T. Carrano, Timothy J. Gaudin, Richard W. Blob, and John R. Wible, eds. Chicago University Press, Chicago, 2006. 448 pp. \$95.00 (ISBN 9780226094779 cloth).

**A***mniote Paleobiology: Perspectives on the Evolution of Mammals, Birds, and Reptiles* is a Festschrift honoring Jim Hopson, recently retired from his longtime post as a vertebrate paleontologist at Chicago University. From both the introductory remarks by the editors and the final chapter eulogizing Jim, it is clear that he has inspired great affection and intellectual respect among his students and collaborators, 24 of whom have contributed to the volume. In these days of