



Ecosystem Ecology: In Pursuit of Principles
Principles of Terrestrial Ecosystem Ecology by Francis Stuart Chapin,; Pamela A. Matson;
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Book Reviews

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ECOSYSTEM ECOLOGY: IN PURSUIT OF PRINCIPLES

Chapin, Francis Stuart, III, Pamela A. Matson, and Harold A. Mooney. 2002. **Principles of terrestrial ecosystem ecology**. Springer-Verlag, New York. xiv + 436 p. \$149.00 (cloth), ISBN: 0-387-95439-2 (alk. paper); \$52.95 (paper), ISBN: 0-387-95443-0 (alk. paper).

When Terry Chapin began teaching at Berkeley in 1989, he realized that his long experience as an ecologist had yet failed to provide him with the general principles governing ecosystems or an organizing framework for the many ecosystem patterns and processes we can now describe. He embarked on a search, shared with Pam Matson, who was then co-teaching with him, and with Hal Mooney at Stanford, which resulted in *Principles of terrestrial ecosystem ecology*. This book provides an excellent framework for teaching advanced undergraduates; it also provides a rich list of ecosystem principles, some better substantiated than others, which will stimulate the interest of researchers.

The first challenge in teaching ecosystem ecology is to figure out where to start, given that everything depends on everything else. This book manages to convey clearly the interdependence of ecosystem processes and controls, but develop them in a logical sequence. The first section of the book addresses the "state factors" controlling ecosystem development. The chapter on climate is outstanding; like the sections on soil and water and energy balance, it allows students to take this course without prerequisites, and makes clear the need for integration and understanding of these fields. Carbon balance, production, decomposition, and nutrient cycling are the heart of the subject, and these chapters are at the heart of the book. Trophic dynamics are covered next, the relevance of which becomes clear in the following chapter, which treats the importance of functional species groups to ecosystem function. The third section of the book has chapters on temporal dynamics, including disturbance and succession, and on spatial pattern ("landscapes" is used unconventionally to describe patch interactions at any scale). The final section applies ecosystem ecology to global cycles and to resource management.

The organization of the book is itself a contribution to ecosystem ecology. Consistent with this framework, diagrams for each ecosystem process show short-term proximate controls, long-term distal ones, and the interactions among them. The long-term controls are further divided into "state factors" and "interactive controls," with the latter both controlling and controlled by ecosystem characteristics. This distinction may be too blurred, however, to justify introducing a new term, as even Hans Jenny's state factors (climate, topography, parent material, biota, and time) are not the independent variables we once thought them to be. Climate is clearly sensitive to ecosystem processes at a variety of scales, and even the character of sedimentary rocks depends on the ecosystems in which the sediments were produced.

The book is full of fascinating generalizations that will capture the imagination of students and challenge the research community. For example, "[t]he climatic controls over NPP are mediated primarily through the availability of below-ground resources. . . . No one has tested whether addition of light would stimulate the productivity of any natural ecosystem." "[L]ower N:P ratios in terrestrial herbivores than in plants suggests that. . . phosphorus could be a more important nutritional constraint for animals than is generally recognized." The reader could be helped by some indication of the confidence we should have in these concepts, where they are not supported by references. For example, what is the evidence that amine groups bind organic matter to clay or that mineralization is accelerated in the rhizosphere?

The scope of this book is unprecedented in this field, so it is hardly surprising that some areas could be improved. For example, soils receive more emphasis than in other ecology texts but still less than they deserve, and the presentation of taxonomy, acidity, phosphorus chemistry, and soil organic matter is not uniformly clear or correct. A pool and flux diagram would clarify the concept of NPP, and the treatment of decomposition should acknowledge more explicitly the importance of root turnover. Aquatic systems receive a chapter, and aquatic examples dominate the chapters on trophic dynamics and management applications.

The book was used by Chapin and Matson's students during its six-year development, which may explain how it became so user-friendly. Throughout the book, key statements are bolded, which help to organize the text. Each chapter has a summary, review questions to stimulate critical thinking, and a list of additional readings. The writing is clear and concise, and there is a good glossary. The key points and figures from each chapter are available in PowerPoint presentations on the internet (www.faculty.uaf.edu/ffsc). To further the pursuit of ecosystem principles and concepts, Terry's web site will provide a forum for discussion of ideas and a collection point for improvements and corrections to the book. We hope that this textbook will not only serve students for many future editions, but will also provoke wide discussion that will advance our thinking in this field.

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