Book Reviews


Key words: education; sustainable development; university consortia.

This book is a compilation of articles by faculty involved in developing and instituting programs to teach sustainable development (SD) to students in a manner that builds on the service-learning model being used by other programs. In most cases the universities are in Massachusetts, either at University of Massachusetts Lowell or a consortium of universities in the Holyoke, Massachusetts, area. The authors describe their efforts and, more importantly, the successes and the difficulties of putting into place and maintaining the SD programs. Reading this book would enable other faculty groups to begin putting together their own local effort in SD. The manner of coordinating with government, non-government organizations, and companies are described, not step-by-step, but in an anecdotal style with sufficient detail that others could put together their own plans. However, the overall picture drawn in the book is both encouraging and discouraging, so individuals will have many issues to consider before moving forward. The chance of sustaining an SD program is not guaranteed, but this book would give others a better opportunity of success. The number of ideas on how to develop an SD program is large and the personal observations of the participants are insightful. As an administrator, I find this book valuable in providing me with the appropriate fiscal and organizational questions to be asked during the development of an SD or equivalent program within my college.

Most heartening is (1) the ability of faculty to form broad multi-disciplinary groups that include faculty from the humanities, economics, environmental science, and engineering, and (2) the great level of community and corporate support. Most discouraging is the observation that support from university administrations was difficult to obtain. Perhaps this is because administrators were thinking about long-term funding and, indeed, when external funding ceased in some described programs, continuation became even more difficult.

The chapter I find most compelling is “The role of the humanities and social sciences in education and sustainable development” by Daniel Egan, Vanessa Gray, Whitley Kaufman, and Chad Montrie, because it raises issues that I, with a disciplinary background in environmental microbiology, have not really considered. For example, problems arose because the meaning of SD was not self-evident to everyone and because the interpretation of the term differed depending on academic discipline. The authors in this chapter discuss their own disciplinary perspectives and how they affect their interactions with their students in history, sociology, political science, and philosophy. Gray (the political scientist) was concerned that “if I successfully convince students of how grave and how complex the ecological crisis is, I will contribute to their passivity or even nihilism.” Her response was to add discussion of successful SD remedies, but even some of these might raise problems in the minds of others. For example, she points to the China one-child policy as being a successful SD policy, yet from other points of view it could be argued that it was not. Kaufman (the philosopher) points out that “the very concept of sustainability is at best a starting point for consideration of the multiple conflicting values at stake,” raising the issue for me of how difficult it is to present a total picture of SD for a student or professional.

For the university administrator, “Merging academics and operations in a statewide university consortium” by Patricia Jerman, Christy Friend, Corinna McLeod, Summer Smith Taylor, and Bruce Coull is a must read. It points out many of the problems associated with establishment and sustainability of any program, especially an SD program using the University of South Carolina and Clemson as examples. They even point out the waning enthusiasm of faculty for participation once stipends and other rewards obtained from special funding begin to disappear. This is a brutally honest chapter.

For those programs that include departments such as engineering or many computer science programs with professional accreditation requirements, William Mass’ chapter “Teaching sustainability and professional ethics: production and values in and outside the work place” addresses how a course or program of courses can be incorporated into the requirement for ethical training required by the Accreditation Board for Engineering and Technology (ABET). The discussion includes some details on the incorporation of design elements, participation in working teams, and appropriate learning outcomes that are accreditation requirements.

The book is interesting and helpful in focusing my own ideas and concepts on SD. It is well written and thought provoking. However, it does lack much input from scientists and engineers that are highly involved in SD programs, leaving me with the impression of imbalance. This imbalance might be greater or less depending on the background of the reader.

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GENTLE INTRODUCTION TO COMPLEXITY ON LANDSCAPES


Key words: biodiversity; cellular automata; complexity; global change; landscape ecology; simulation modeling; sustainability.

Why are starfish like an atomic bomb? The answer, according to the co-authors of *Complexity in landscape ecology*, is that like the chain reaction of atomic fission, starfish larvae set off a chain reaction of outbreaks by first settling on a coral reef and then, with help of oceanic currents, dispersing to other reefs. Such a dynamic occurred in the early 1980s along Australia’s Great Barrier Reef, when the Crown of Thorns starfish (Acanthaster planci) literally ate away vast stretches of the famous reef network. However, the authors posit, it was only by appreciating the biological connectivity of these organisms in fragmented reef landscapes that the disruption of the reef community could be understood. This example highlights the authors’ thesis and the general and rapidly emerging consensus in ecology that the ability to interpret and predict ecological behavior of populations across spatial landscapes is critical for understanding such processes as disease spread, evolutionary genetics, and species dispersal.

This book is meant to be a “gentle introduction” to the field of complexity and landscape ecology (David Green, Preface). The authors begin with a general overview of human development in the Amazon basin as an example of how “simple assumptions about ecological systems can lead to disastrous mistakes in land management.” According to the authors, the tragic mistake made in opening the Amazon for development was to assume that the forest results simply from suitable climate and soils, rather than as a result of complex dynamic processes—processes that ultimately make the land unsuitable for continuous agricultural development. Similarly, the plight of the Murray River in Australia cannot be appreciated without understanding the accumulation of local behavior along its entire length. Grounded in these examples, the authors present their idea that complexity, i.e., the “richness and variety of form and behavior that is often seen in large systems,” is at the root of these and similar ecological conundrums. Biodiversity is touted as the most common example of complexity in ecology. Specifically, they argue that the variety and ways in which species interact with each other and across space, not just the number of species involved, makes biodiversity a rich subject for studying complexity in ecological systems.

In the early chapters, David Green and colleagues explore biological complexity in detail. They explore plant growth through modulation and repetition that makes plant growth self-similar, e.g., fractal (Chapter 2). Following a perhaps overly long discussion of L-systems (“a technique for constructing complex objects by successively replacing parts of simple, initial objects using rewriting rules”), the authors go on to show that simple interactions among animals (ants, bumblebees, starfish) result in complex behavior. Then, the authors move, finally, to landscapes (Chapter 3), and following a rudimentary discussion of geographic information systems, discuss cellular automata models of landscapes. The authors review the essential features of cellular automata models and their application in studying important processes (e.g., fire spread, spread of epidemics, biological invasions). They review concepts of connectivity, percolation and critical phase changes. The roots of complexity theory, networks, connectivity, and self-organization are explored further in Chapter 4. Basic concepts of equilibrium using classic examples of predator-prey systems are addressed in Chapter 5. Distributions of populations in landscapes based on nonlinear and complex biotic interactions are discussed in Chapter 6 and 7. While the latter chapters begin by reviewing concepts familiar to ecologists, they end with discussions of attractors and chaos theory (Chapter 5) and network interactions (Chapter 6 and 7) that are both interesting and approachable.

Whereas the foregoing chapters show how biological complexity has helped explain observable dynamics among individuals and populations, the remaining chapters highlight potentially new ways of appreciating these dynamics. For example, the authors suggest that landscape genetics and evolutionary theory may be informed by understanding phase changes in landscape connectivity at many scales (Chapter 8). They suggest that simulation models could be used to explore both virtual and real worlds to determine when our understanding of complex dynamics is supported (or fails), and to reconstruct worlds based on this understanding (Chapter 9). But, they caution, learning about complexity requires an infrastructure for information management that is attuned to issues of data quality, control, and cost (Chapter 10). In the final chapter, the authors discuss the interactions between humans and the global landscape, exploring the implications for human societies and the environment.

Surprisingly (based on its title) the authors do not emphasize landscape ecology and some of its main contributions. Thus the book is more a gentle introduction of complexity to landscape ecologists (or, ecologists generally) than it is a gentle introduction of landscape ecology to complexity theorists. For example, some of the seminal literature in landscape ecology (by, for example, Richard Forman, Simon Levin, Monica Turner, Dean Urban, John Wiens) are glaringly absent. While complexity is defined, landscape ecology is not. Scale is defined in the context of fractal dimension, i.e., a measuring stick, rather than with concepts common to landscape ecologists, e.g., grain and extent. Similarly, a “patch” is not defined and thus patchy landscapes are defined from a modeling context as “a grid in which each cell represents an area of the land surface.” Interested readers may also find contributions from spatial statistics or spatial ecology to be missing, even in a discussion of sampling and scale. Instead, the focus, perhaps refreshingly, and appropriately, based on the experience of the authors, is on the field of complexity and its contribution to understanding ecology on landscapes rather than the discipline of landscape ecology per se.

The intended audience is a little unclear in another way too. The authors go to the trouble of defining techniques or concepts that most literate ecologists should be familiar with (e.g., a quadrat, GIS, a food chain, location; do you really need to have latitude and longitude defined for you?). Yet the book is not organized to be used as teaching material. There is a quick mention in the preface of a webpage (http://www.complexity.org.au/vlab/) with online demonstrations to accompany the book, but although many of the figures directly result from the models on this webpage, there is no direct mention of it in the text. The webpage itself is a fun tour of cellular automata
models and might serve as the basis for laboratory activities. Yet, if on the other hand, the book is meant to be a resource for ecologists who are eager to grasp complexity theory, some may be disappointed by the erratic use of citations (some chapters are full of citations, while others are almost absent) and the fact that many of the citations were very old, i.e., I counted only 12 peer-reviewed references from 2003 or later. The fact that I was inspired to count them is perhaps evidence enough!

The most frustrating aspect of the book for me was that concepts, analogies, examples, and even definitions were repeated among chapters. For example, discussions of emergent behavior, the reductionist approach, and fractals were repeated in several chapters, which caused me to wonder “didn’t I already read this?” Although this may not bother the casual reader interested in a single chapter or two, and may have been intentional, it detracted from the logical progression of the book’s thesis.

Despite these caveats, the book succeeds in its goal to be a gentle introduction to these subjects for several reasons. First, the integration of concepts as diverse (and yet interconnected) as genetics, complexity, information theory; virtual worlds, and biodiversity is rarely attempted. The authors present a compelling thesis that understanding the complexity of these interactions is necessary for being able to interpret and forecast ecological change. There are a number of persuasive examples within the book that serve as good lessons for appreciating the extent of these biological interactions. Second, by integrating these subjects in one book, they are made more accessible to a wider audience. For example, field ecologists wedded to a particular species, process, or place in space may be enlightened about the role of cellular automata models in simulating dynamic processes using simple information; landscape ecologists may find a greater appreciation of landscape genetics (I did); educators may be inspired by virtual tools and techniques of communicating complexity. Moreover, the general conclusion that local action has global consequences is affirming to most ecologists, though not entirely new.

Finally, the most inspiring idea in the book is that seemingly complex ecological phenomena can often be explained by simple assumptions grounded in complexity theory. As such, this book could serve as a springboard for stimulating research about other general ecological principles that could better explain populations in landscapes. Unfortunately, the book falls short of providing these synthetic answers itself. Rather, I recommend the book to those who need a simple introduction to this complex topic from the perspective different from the traditional ecologist or landscape ecologist. Those already embedded in questions of biocomplexity, or with perspectives not centered on biodiversity and species interactions, or who want a tighter and more sophisticated read, may be somewhat disappointed.

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Key words: complex systems; environment and people; methodology of science (ecology); modeling.

A good book! The book by Peter Taylor may represent yet another indicator that ecology matures. It reflects on the past, examines current challenges, and offers methodological solutions for ecology to succeed in the complex interplay of scientists, funding, and societal needs. It focuses on the nature of fundamental problems of ecological research as exemplified by modeling activity. Correspondingly, the book has three parts, which gradually move from issues of basic science to the applied realm.

The writing is clear and persuasive but the greatest strength of the exposition is a considerable degree of insight, original evaluations, and methodological depth. This is a book written by an expert with a broad view of the world. Taylor’s book will be most interesting to three groups of ecologists: those who feel the need to evaluate the state of science and to reflect on trajectories it has followed; those who wish to reflect on the meaning and limitation of their modeling efforts; and those who grapple with the complexities of applying science to systems consisting of people, tradition, governments, international agencies, ecology, and environment. At the same time, I would encourage other ecologists to read it as it offers a refreshing perspective on some classical areas of focus that we all are familiar with. This is particularly so because the book is a graceful critique of ecologists being seduced by ideas of the time or by their own rhetoric in spite of obvious flaws in how these ideas were formulated or in what prominence they were given. A notable example involves one of the most recognizable names—W. C. Allee—and the correlations among his personal, social, and scientific pursuits. An inescapable conclusion from this section will be that the vulnerability to misjudgment continues. Increasing awareness of this vulnerability may have a salutary effect for ecologists.

Taylor starts with a set of observations on what ecological models are, what they can and cannot do for us, and why simple models suffer from hidden complexity that may undermine their usefulness. While doing so, he educates us about the dialog between the models and observations and the many facets this dialog can have, each with its own set of advantages and problems. To make his points, he re-examines some longstanding and recently revived questions such as the relationship between complexity and stability of ecological systems. I have a small gripe here. While Taylor acknowledges that models are embedded in a broader framework, he refers to this framework as the network of complexity. Others have argued that such a framework is indeed much more than a system of models. I suspect that Taylor would agree but this is not the sense his writing conveys. Nevertheless, I found this section of the book very interesting because it clearly identifies some fundamental questions of ecology. For example, he asks, “If complexity in
general does not promote stability, what are the ‘devious strategies which make for stability in enduring natural systems?’ A question like this can be a starting point of a research program. This book supplies many more.

Next, Taylor uses Howard T. Odum’s approach to modeling of ecological systems (and other systems) and the maximum power principle to identify a variety of caveats among which the loss of relevant detail and the ambiguity of the boundaries acquire the greatest importance.

As he discusses modeling in general and then modeling arising from Odum’s ideas in particular, Taylor consistently develops a theme of correlations among the practice of science by individuals, their personal life, and the society they function in. Again, he allows this theme to have many sides, with influences springing in various directions, branching and interacting with each other. When analyzing Odum’s work, he offers an excellent analysis of methodological foundations, limitations, and relevance to ecology. Entertainingly, he points out that H. T. Odum thought of himself as a prophet—not to ridicule the outstanding scientist but to show how strongly his science and life mission were tied.

The third part of the book, along with a few chapters immediately preceding it, is devoted to engaging science with the social and economic fabric. This part is less general in its conclusions but nevertheless most interesting for the choice and quality of examples on which Taylor bases his observations and insights. I found stories of African pastoralists particularly interesting. Taylor shows how history, climate, pressure from surrounding social change, and their own changes of economical goals affect their struggles. More importantly, he shows how complex a picture one has to paint in order to build a sensible model that is likely to advance understanding and guide management. Many other useful examples abound and serve the purpose of illustrating how a research perspective always evolves in response to details of context revealed in the process of investigation. It is impossible to refer to all the angles, conceptual devices, and examples contained here but they all contribute to making the book a fascinating exploration of science as a social endeavor, with many attending lessons.

One inclusive theme permeates the book and can be viewed as the “agenda.” I like it although I disagree with the emphasis. Taylor boldly challenges the distinctions between science and the social context within which it is practiced. This perspective is not foreign to philosophers of science but needs continual reinforcement with science practitioners. More importantly, he argues that environmental systems (however conceived) are not well bounded, that their dynamics change, and that our understanding of them arises from and is constrained by a dialog with the social system. While doing so, he provides sophisticated insights into the sociality of science in its many facets (within the community and with society at large). Here, I agree with most of what he suggests. However, I am not sure if the observation that systems are often only weakly bounded implies that we should abandon research predicated on boundaries. The latter seems to be the thrust of the arguments made by Taylor. Granted, the matter is important and requires ecologists to fully engage intellectually. Recognizing flaws of the perspective that relies on boundaries for designing research questions and protocols does not translate, in my opinion, into an argument on behalf of a research program that ignores boundaries. Still, the fact that Taylor raises this issue and offers alternatives is one of the appealing factors of his book.

I found Unruly complexity a stimulating and thoughtful read. It is not to say that the book is an easy read—rather it is as easy as the complexity and depth of the topic allows. It has the double quality of being able to clarify the issues and provoke thinking on unresolved issues. Taylor clearly recognizes that his book on complexity is complex and thus he helps the reader with a “Summary of themes and questions opened up.” I think it is a very useful device that has a potential as an opening for a good graduate course. Anyone interested in how the science of ecology evolves in response to social, philosophical, and political context and how it interacts with environmental analysis and management will consider the time invested in reading this book well spent and will learn many lessons.

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