

Book Reviews

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TROPICAL DRY FORESTS

Bullock, Stephen H., Harold A. Mooney, and Ernesto Medina. 1995. **Seasonally dry tropical forests**. Cambridge University Press, New York. xvii + 450 p. ISBN: 0-521-43514-5.

Tropical dry forest, characterized by Dan Janzen as the “most endangered tropical ecosystem,” once covered vast tracts of the earth, but now occupies only a very small fraction of its original area. The species richness of dry forests is not as high as that of humid forests, but these forests are an important reservoir of biodiversity, and a significant source of goods and services to human societies. The relatively simple structure of dry forests makes them more suitable to unravel ecological patterns and processes than their wet counterparts, and indeed, some of the most significant insights into ecosystem structure and function in the tropics have had their basis in research conducted in dry rather than in wet forests. However, despite the biological importance of these forests, their intense and prolonged use by humans, and their rapidly diminishing size, not a single book exclusively devoted to the ecology of the dry forests has been available until the publication of this volume. This book, edited by Stephen Bullock, Harold Mooney, and Ernesto Medina, represents the output of a symposium held at the Estación de Biología Chamela, Jalisco, México. The date of the symposium is not specified, but most papers seem to be current, as indicated by their list of references.

The papers can be grouped into four broad categories. The first category includes reviews with emphasis on the structure and general features of dry forests in different parts of the world; the other categories are ecosystem processes, including species interactions, conversion, and ethnobotany. Most papers deal with Central American forests, acknowledged by the editors as the focal region of the book. However, there are some chapters from Asia and Africa. Moreover, references to work in all tropical regions of the world are scattered throughout most chapters.

Perspective on the structure and composition of dry forests are provided for Central America and the Caribbean (Murphy and Lugo), Brazilian caatinga (Sampaio), Africa (Menaut, Lepage and Abbadie) and Thailand (Rundel and Boonpragob). Diversity of life forms is a separate topic in the chapter by Medina. These chapters highlight several features: tropical dry forests are less diverse than wet forests; total biomass of trees and net annual primary productivity are also lower, but the diversity of plant life forms is greater; and the human impact is intense.

Complementing these studies of contemporary forests, Graham and Dilcher describe changes in the composition of the plant communities in the Americas based on the fossil pollen record. Dry forest elements first appear in Mid to Late Eocene, increase in diversity through Mid Tertiary, and can be recognized as a part of a distinct community in the Miocene/Pliocene.

The global perspective is provided by Gentry. On the basis of 28 sample plots established throughout the world, Gentry concluded that although dry forests are less diverse than wet forests, diversity in dry forests, beyond a certain threshold of precipitation, does not increase with an increase in annual rainfall. Gentry also noted that although tropical dry forests share many genera and families with wet forests, species overlap is minimal. Furthermore, various dry forests differ in their species composition as well as in levels of endemism. He also pointed out that centers of endemism are not equatorial but near the tropics. Thus, efforts to conserve dry forests cannot be restricted to a single geographical region.

A number of chapters cover ecosystem processes such as primary production (Martínez-Yrizar, nutrient cycling (Jaramillo and Sanford), nitrogen trace gas emissions (Matson and Vitousek), soils (Cuevas) and drought responses (Holbrook, Whitbeck, and Mooney). Some of the common themes include comparisons with wet forests, responses to the pronounced dry season, and a general lack of information about basic processes. However, the authors and editors do not take advantage of the opportunity to address a common set of conceptual issues concerning ecosystem processes.

Species interactions is the topic of two chapters: plant reproduction (Bullock) and plant-herbivore interactions (Dirzo and Dominguez). Bullock’s masterful review of various aspects of reproduction, including phenology, pollination, seed dispersal, and mating patterns brings together a wealth of information. This is by far the most comprehensive chapter in the book, with the longest list of citations. The chapter on plant-herbivore interactions is a useful documentation of community and population level patterns and the consequences of herbivory.

Animal diversity is the subject of only one chapter on vertebrates by Ceballos; the editors comment on a lack of information on invertebrates.

Maass explores the causes and consequences of conversion of tropical dry forests into other types of land uses and, like others, pleads for more research on sustainable land use in areas occupied by tropical dry forests. Much of the tropical dry forest has been converted to pasture and agriculture. Thus, unless the economic consequences of conversion on other land uses, particularly agriculture, are fully explored, pleas for sustainable land use are not likely to receive much attention.

In the final chapter, Bye briefly comments on the economic uses of plants in tropical dry forests of Mexico. He lists a number of plant species that are harvested and provides ecological and economic data for these taxa. Tropical dry forests have been extensively used by humans for millennia and offer a rich source of material for ecological and economic analyses. However, Bye, like several others in the volume, misses the opportunity to address central questions about how the extent of use might be linked to the enhancement of rural incomes and conservation.

Overall, this volume brings together, for the first time, considerable information about structure, function, and human use of tropical dry forests. Thus the book should be of immense value to ecologists throughout the world. Its value could have been enhanced if the editors had taken a little more time to provide a conceptual framework for various topics and to pose questions for future work. The introductory comments by the editors are very insightful, and readers could have benefitted from more detailed commentaries.

The book is dedicated to Alwyn Gentry, whose paper in the volume demonstrates how insightful he was, and how

much we are likely to miss his contributions to tropical ecology. Gentry inspired and challenged his colleagues to look for patterns and to seek explanations for these patterns. This volume keeps alive Gentry's spirit and provides a glimpse of the challenges and opportunities that dry tropical forests offer to ecologists and conservation biologists.

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ENSURING ECOLOGICAL DIVERSITY

Snappe, William J., III (ed.). 1996. **Biodiversity and the law**. Island Press; Washington, D.C. xxvii + 259 p. \$49.00 (cloth), ISBN: 1-55963-394-8 (acid-free paper); \$25.00 (paper), ISBN: 1-55963-395-6 (acid-free paper).

As noted conservationist Aldo Leopold concluded in *A Sand County almanac*, the first rule of intelligent tinkering is to save every cog and wheel. The current legal and political approach for managing biological diversity, however, violates that rule. Today, virtually every element of the natural environment is being lost: species decline, communities decline, habitats dwindle, and ecosystems disappear. The current framework for assuring a biological future, in short, does not work, and the prospects of life without diversity should trouble even the most positive idealists. As anyone beyond the third grade knows, a world without diversity is a world without life.

Snappe makes sense of these difficult issues with a collection of first-rate articles and essays on biological diversity law and policy. Snappe's effort, a result of a Defenders of Wildlife conference held in March 1994, is not a typical legal treatise with *n*th-order footnotes and elegant, but impractical legal theories. Nor is it simply a rehash of the primary U.S. environmental law devoted to the topic, the Endangered Species Act (ESA). It is, instead, a testimony of wisdom on diversity as an ecological and legal topic, offering historical background, sharp analysis, and useful documentation on a wide range of related issues.

Just what is "biodiversity," and how does the legal system and its players treat biodiversity? That is the subject of the first section of the book. At its most literal level, according to Snappe, biodiversity represents the variability of all natural life forms; at a more sophisticated level, biodiversity is the sum of all genes, species, habitats, and natural processes that constitute the very essence of existence on earth. For some, biodiversity represents a tangled web of nefarious ideas with absolutely no legal relevance. As developed throughout the book, however, the key legal question is not whether biodiversity is worthy of government regulation, but whether gov-

ernment offers the appropriate skill and framework to ensure and protect biological diversity throughout the future.

In the book's Foreword, Oliver Houck calls the concept of "biological diversity" the new organizing principle for life on earth. While the concept deserves close scrutiny as an organizing precept, Houck sees three problems preventing biodiversity from becoming the key framework: first, the lack of precision on what constitutes biological diversity; second, the lack of public awareness on what diversity actually is, and, third, the lack of mechanisms for incorporating the idea into human institutions so that, over time, life on earth remains biologically diverse. The problem with biodiversity as a legal and social concept, Houck concludes, is that in a world rife with streetshootings, grinding inequality and ethnic wars of extermination, it is hard to get worked up over "ecosystems."

Following Houck's wise take on the current situation, the book's first of four parts reviews the scientific and policy foundations of biodiversity and the law. Here, Molly Beattie, Director of the U.S. Fish and Wildlife Service, reviews the U.S. government's view of biodiversity and ecosystem management, but provides no persuasive evidence that the government's acts will make any progress toward these goals. In this section, Donald Waller analyzes the biodiversity concept as a basis for conservation and natural resources management. Waller marshalls strong evidence the ESA, by concentrating on individual species, actually vilifies species and stimulates increased polarization over the ultimate value of diversity. The ESA also wrongly concentrates on the furry and feathery charismatic "megafauna," Waller maintains, while ignoring the inconspicuous and endangered species. But it is also here we learn that concerns for biological diversity include broader ecological processes and landscape concerns, contrary to what many first-time observers would suspect.

The second section covers the current legal framework for handling and sustaining biological diversity. Early on in this section, Jason Patlis provides a first-rate overview of the ESA, noting that while "ecosystem protection" was mentioned numerous times in the legislative history of the Act, the concept

of diversity—above and beyond concern for species—was never transposed into judicial interpretation or regulatory respect. Also in this section, Lindell Marsh offers a case study on the San Bruno Habitat Conservation Plan, an attempt at ecosystem management and intelligent natural areas planning. For Marsh, the key elements of this ecosystem planning program's success—at least current success—were the facilitation process itself, common technical support, and committed stakeholder involvement.

In one of the more enduring contributions of the book, Todd Olson makes a fundamental point: even if laws protecting biodiversity could be strictly enforced, a policy that sets the environment and private property fundamentally at odds cannot endure for long. For Olson, the common enemy of conservationists and landowners is an economic system that fails to take into account the social value of diversity—and that creates incentives to destroy biodiversity. What is needed, Olson suggests, is a system that values diversity just as it values tennis shoes. As a solution, Olson proposes the “habitat transaction method,” which develops and interrelates biodiversity measurement and economic value in a regional setting.

International issues relating to biodiversity are discussed in the third part of the book. As Snape notes, holding multinational actors accountable to international and domestic biodiversity standards may be the greatest challenge presently facing the global legal system. As support for this point, Leesteffy Jenkins explains how biodiversity emerges in trade requirements and trade treaties, showing how the General Agreement on Tariffs and Trade (GATT) ultimately weakens biodiversity and environmental management in countries throughout the world. After this, Peter Jenkins follows with an astute summary of the impact of “harmful exotics” on biodiversity in the United States, concluding that while non-indigenous species ultimately shape biodiversity, the legal system has ignored this aspect of the problem. Discussed here are the International Plant Pest Convention, the Lacey Act and other legal efforts to address this topic.

Continuing with the international theme, Suzanne Iudicello turns to global marine issues because biological diversity in the sea also remains in serious jeopardy. The marine diversity problem stems from five sources, Iudicello concludes: pollution, habitat alteration, alien species, climatic and atmospheric changes, and overexploitation. While the “big stick” of trade sanctions may have the power to control marine diversity, Iudicello maintains the GATT, the most important trade agreement, dilutes any real potential effectiveness of this effort.

Also in this section, Scott Hajost and Curtis Fish make sense of the international instruments devoted to biodiversity, in particular the Convention on Biological Diversity, and review international attempts at managing biodiversity, especially the Rio Earth Summit and Agenda 21. Unlike others addressing the subject, Hajost and Fish recognize the role of multilateral banks in protecting diversity, but note the Global Environment Facility sponsored by the World Bank lacks a convincing, effective framework for the management of natural resources and biological diversity.

In the final part of the book, the contributors evaluate issues related to biodiversity ownership and related public policy

concerns. For instance, Ralph Johnson and William Galloway introduce the “public trust” doctrine, a framework that suggests some aspects of the natural environment, and perhaps even biological diversity, may be held in trust for the public's benefit. The unanswered question is whether the public trust doctrine, originally developed in the context of water rights, really holds promise in the context of biological diversity. A few early court decisions suggest that it does not. Following Johnson and Galloway's contribution, John Pendergrass offers another perspective on the management of biodiversity, from a regulatory perspective. Pendergrass looks at a range of current U.S. environmental laws, examines their biological diversity provisions, and concludes the current framework falls short, but nevertheless could be valuable for ensuring biodiversity. Although Pendergrass suggests the current environmental framework could go a long way to affect biodiversity, the author provides no explanation why, with more than thirty years of experience with this overwhelming set of regulations, biodiversity—at least in the United States—continues to suffer. The assumption, then, is that the current system makes sense despite its shoddy implementation. After the contribution by Pendergrass, a short article by Dinah Bear reviews the pains and progress of the National Environmental Policy Act, a key procedural aspect of environmental policy in the U.S. today.

In “Wildlife's Burden,” Walter Kuhlmann explains how courts have had, and why courts will continue to have, difficulty in recognizing the “ecosystem” concept as a guiding legal principle for environmental law. From this section, we learn that the burden of proof on plaintiffs embracing the concept is too severe: the broader ecosystem concept cannot shake the “prevailing local” approach of legal jurisprudence. The complexity of ecosystems, their fragility and slow pace of change all confuse the legal system. Courts need dead animals, sick children, single species or toxic pollution, not indeterminable scale effects, plausible, but untested theoretical concepts or interrelated, multiple-species interactions.

David Downes ends this section with a chapter on the Convention on Biological Diversity. Here the author provides another perspective on the Earth Summit and the inner workings of the Convention. From this, we learn the Convention takes a different approach to trade and environment: it attempts to unite economic and environmental issues in a relatively balanced way within a single document. In short, the Convention makes it clear the ecosystem includes the economic system, and Downes suggests the United States should ratify the treaty for this reason. Downes warns, however, after reviewing previous efforts at integrating the economy with the environment, that privatization, one of the most common proposals, is not a sure route to sustainability, and the market alone cannot save biodiversity from its worst enemy, *Homo sapiens*.

In the book's Epilogue, Roger Schlickeisen offers one of the most thought-provoking legal analyses of biodiversity available to date. Historical and contemporary interpretations of the U.S. Constitution, Schlickeisen concludes, are at odds with the objective of providing effective stewardship of valuable natural resources and ecological processes. Little in current law protects the myriad life forms and their interactions. What is needed, according to the author, is a constitutional

amendment to protect biological diversity for future generations. Several states have taken such an approach, and the U.S. should follow this approach, Schlickeisen concludes.

All of these sections, while impressive in their own right, suffer one weakness—the failure to consider the role of business in the biodiversity debate. A discussion on the impact of corporate form and corporate responsibility would have been welcomed not only in the legal literature, but in the conservation biology literature as well. For instance, to what extent does the definition of diversity include the concept of “business”? How do private firms, including their human resources practices and their strategic decisions, shape and protect biological diversity? Here the contribution would not have been in how corporations fund nature preserves or environmental education programs, but how firms interact and agglomerate to shape the diversity of natural environments. It may be the hallmarks of a healthy business—diversity, competition, niche marketing—may simply reflect a healthy environment, and a better understanding of the two may sustain both.

Likewise, several chapters in the book assume the legal system can actually preserve biodiversity. That assumption, however, is suspect given the cataclysmic decline in diversity over the past three decades. If the legal system offers the best approach for preserving and assuring biodiversity, even if a

“new and improved” legal system can be fashioned as proposed in several sections of this book, then why has it failed so miserably in ensuring biological diversity? By comparison, a free-market approach may offer the best long term framework for protecting diversity, and this possibility should have received more attention. Olson recognizes the fundamental issues involved in considering a paradigm shift in biodiversity, but the rest of the chapters advocates a “command and control” system when a market system may offer the most hope. Other perspectives, therefore, on managing the problem would have been welcomed.

As an introduction to a range of important issues, however, Snape and colleagues offer first-rate discussion in its best form—short articles from a variety of perspectives from conservation biology and environmental policy. As a collection, the book provides well synthesized reflection that relies neither on heavy rhetoric nor extreme polemic and the effort makes even the most learned scholar take note and the newest student gain a deep appreciation for the issues. That the book does this makes it a success.

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PREDICTIVE LIMNOLOGY

Håkanson, Lars, and Robert H. Peters. 1995. **Predictive limnology: methods for predictive modelling**. SPB Academic Publishing, Amsterdam, The Netherlands. ix + 464 p. \$187.50, Dfl. 300.00, ISBN: 90-5103-104-1.

This book is an intriguing and useful text, although it is daunting at first impression. The authors wrote that they intended it to be both a text for graduate courses and also a cookbook of recipes for predictive modeling. In fact, the large format volume (30 × 22 cm) is packed with hundreds of data tables, graphs, and regression equations, to such extent that your head can literally spin as you try to leaf between text references to items and the graphics which may be pages away. There are both good things and bad things to report, but on balance the good outweighs the bad.

First of all, the book certainly lives up to its title. It gives the reader a fine introduction and how-to course on the construction of regression-based statistical models and on blending these models with simple dynamic equations. There are plentiful and helpful prescriptions about inspecting the data before loading them into the regression hopper. Advice and examples about frequency distributions, transformations, dealing with outliers, and uncertainty analysis are kept simple and direct. The emphasis is on predicting quantitative outcomes, like the amount of mercury in fish tissue, rates of

primary production or sedimentation in lakes, or the chemical contents of the water. The authors make a credible effort to develop an algorithm for measurement of “predictive power” of the models, an effort that requires a way to balance the collective statistical statements embodied in r^2 values with the propagated uncertainty of the model equations and their parameters. The result is a rationale by which to judge whether the increased statistical fit that can grow with model complexity reaches a diminished return in predictive value. Not surprisingly, we learn that the simplest models often make the most powerful quantitative predictions, a lesson that recalls a remark first credited to Einstein: “Everything should be as simple as possible, but no simpler.”

Balanced against the evident good content of the volume is the fact that technical editing and layout leaves a lot to be desired. Numerous sentences are simply ungrammatical, and the prose is less flowing than readers had grown accustomed to from the second author. It is also possible to become distracted by the authors’ habit of informing the reader what the text is NOT intended to do, or how NOT to interpret a result, or what is NOT the aim of the chapter, with capitalized exuberance that seems to shout from print as many as four times on a single page. The reader is continually reminded that the data are drawn “from 25 Swedish lakes,” from 95 Swedish lakes, or “from 926 Swedish lakes” and that model results must NOT be applied to other lake types, sizes, or ranges of

attributes. In that sense, the work is intensely focused, and it would seem that the models must best be treated as analogies to the kinds of statistical treatments that could be applied to lakes in other regions. The restricted regional focus may prove a drawback to its adoption as a text outside northern Europe. It is evident that the first author had at his command a vast matrix of lake survey data for secchi depths, total P concentration, lake water color, alkalinity, conductivity, pH, as well as catchment basin maps, and the book is replete with statistical interactions among these properties, or more commonly their logarithmic, square root, or exponential transformations. Clearly Håkanson has achieved success with efforts to model environmental properties of practical necessity, such as mercury and radiocesium contamination of the lakes and landscape, and this book teaches how to do so, step by step.

My deepest sadness, however, was to learn while reading

this book that the second author, Rob Peters, had passed away after a painful illness. This is a tragedy for our science. This text gives us a glimpse of a maturing face of the discipline that Peters had promoted so eloquently as "predictive limnology." Here we find efforts to develop predictions that are based on underlying causation, and to forge a union of mechanistic processes with empirical patterns. The emerging models promised to be ever more useful, instructive, and illuminating. We mourn the loss of a great intellect, but one who has enriched us with a legacy of philosophical and scientific work that will endure and grow.

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POLLINATION REVIEWED

Proctor, Michael, Peter Yeo, and Andrew Lack. 1996. **The natural history of pollination**. The New Naturalist Series. Timber Press, Portland, Oregon. 479 p. \$42.95 (cloth), ISBN: 0-88192-352-4; \$24.95 (paper), ISBN: 0-88192-353-2.

Pollination biology and plant reproductive ecology are active research areas with long histories and enormous literatures. A student or other neophyte entering these areas needs a thorough understanding of both plants and their animal pollinators, and must master a long list of bewildering jargon. One book that was frequently turned to in the past was Proctor and Yeo's *The pollination of flowers*, but since the publication of that book in 1973 the field has undergone a rapid expansion. *The natural history of pollination* is a complete re-write of the earlier book, covering many developments in pollination since 1973. In addition, the authors have tried to cover more examples from outside Britain. The new book succeeds in providing an up-to-date introduction to the natural history of pollination.

The book opens with an interesting history of pollination biology. The second chapter gives a very clear summary of floral biology and terminology, which will be very useful to those without a strong botany background. The next nine chapters constitute the bulk of the book, and provide exactly what the title promises: a thorough overview of the natural history of pollination. These chapters are not always easy reading, because they consist of many detailed descriptions of the enormous diversity of flowers, pollinators, and pollination mechanisms. One can skim these chapters and get an overview of this diversity, however, and then refer to the details when necessary. Despite the general lack of conceptual material in these chapters, the natural history information suggests questions and species for future research. The chap-

ters centered on insects are less successful than the others, as they are less well-organized and rely heavily on a few older sources. This points out a strength of the book as a whole, however; it summarizes older literature that is difficult to find and often not in English. Readers who want a more complete review of the insect side of pollination could consult F. G. Barth's *Insects and flowers: the biology of a partnership* (1985. Princeton University Press, Princeton, New Jersey).

The final five chapters are more conceptually oriented and are primarily focused on the ecology and evolution of pollination. I found these final five chapters to be the most interesting in the book. The first of these provides a useful overview of the sometimes-perplexing diversity of plant mating systems. The second covers pollination in agriculture and the third reviews the evolutionary history of flowers and pollination. The next chapter on ecology draws several interesting and reasonable general conclusions that should stimulate debate and research. The last chapter on microevolution is clear and accurate, but it could have been improved by including recent studies that directly measured pollinator-mediated selection on floral traits, since these are relevant to an understanding of the diversity of floral forms described so thoroughly in the earlier chapters. An important theme running throughout the book is the flexibility and generality of most pollination systems, in contrast to the few well-known examples of highly specialized plant-pollinator relationships.

Overall, the authors have done a thorough job of updating the previous version; there are well over 1000 references cited, with many from 1995. Although the examples are still weighted toward British and European species, the authors have succeeded in broadening the geographical scope of the book considerably. A particular strength of the book is the large number of excellent illustrations, including line drawings, black and white photographs, and color plates. The book

is very reasonably priced and attractively produced, with reasonably few typographical errors (I found eight in over 400 pages).

In summary, *The natural history of pollination* provides a good overview of the extensive pollination literature. It is most useful as a reference, but not thought-provoking enough for a graduate seminar or course textbook. This book, combined with the books by Barth (see above) for additional insect information and Kearns and Inouye (*Techniques for pollination biologists*. 1993. University Press of Colorado, Niwot, Colorado) for methods and additional references, give

an up-to-date basic introduction to pollination biology. A needed addition to this group is a more conceptually-oriented volume along the lines of L. A. Real's now somewhat dated *Pollination biology* (1983. Academic Press, Orlando, Florida).

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THE BIOLOGY AND CONSERVATION OF MIGRANT BIRDS: PAST DISCOVERIES AND FUTURE DIRECTIONS

Rappole, John H. 1995. **The ecology of migrant birds: a neotropical perspective**. Smithsonian Institution Press, Washington, D.C. xvii + 269 p. \$35.00, ISBN: 1-56098-514-3 (alk. paper).

Neotropical migrant birds hold a dual interest for ecologists. First, they provide examples of extraordinary evolutionary adaptations. In order to travel long distances to find suitable resources with which to breed, or to survive the winter, migrant bird populations have overcome many physiological and ecological obstacles. Second, neotropical migrants are important because many species are undergoing declines in the face of anthropogenic changes to both their wintering and breeding grounds. John Rappole, in his wide-ranging and thought-provoking book, *The ecology of migrant birds: a neotropical perspective*, addresses both the biological and conservation issues surrounding neotropical migrants.

Whereas some books attempting reviews of relatively broad subject areas simply review the information that has been discovered to date, Rappole provides us with both an astute summary of the past and a research blueprint for the future. He does an outstanding job of carefully weighing the rigor of alternative hypotheses and then steering the reader to an understanding of the specific research questions that must be addressed if we are to expand our understanding of migrant biology. Rappole employs an outline format that is common in books attempting to cover a large topic area comprehensively. Chapters address such topic areas as habitat, resource use, migrants in tropical communities, migration, the evolution of migration, a comparison of Old World and New World migration systems, population changes, and conservation. In each of these topic areas, Rappole proceeds to outline sub-topics of particular importance. The organizational style is generally effective, although in a couple of instances, where subheadings are followed by as few as 21 words, consolidation could have been used.

The book includes 39 pages of references; this list alone will be worth the purchase price for students of migrant ecology. In addition, Rappole has included five useful appendixes

(he should be applauded for including a list of Spanish common names and their counterparts), as well as a number of informative tables within the text. These components all contribute to make the book a high-quality resource for investigators of avian migrants.

Rappole effectively reminds the reader that not all of the ecological folk-wisdom about migrants is necessarily true. He points out, for example, that not all migrants are wanderers in their tropical wintering grounds, that not all migrants utilize marginal habitats, and that in general, migrants do not seem to influence the breeding periods of residents. In the chapter on the evolution of migration, *The ecology of migrant birds: a neotropical perspective* makes a compelling argument for the hypothesis that neotropical migrants originated in the tropics, and later evolved migratory behavior to escape intense competition for breeding sites. In the chapter on population change, Rappole summarizes the state of migrant populations and some of the potential reasons why 109 neotropical migrants have shown significant declines in the last decade. He is careful to point out that procedural and statistical biases could potentially produce inaccurate estimates of population changes.

In the final chapter of the book, Rappole summarizes some ideas about what can be done to slow the decline of threatened migrant species. In this chapter Rappole points out the most important environmental problem facing society: human population growth. "This single factor," he writes, "is the ultimate cause underlying the complex myriad of proximate factors that threaten tropical biodiversity in general and avian migrants in particular." Rappole outlines a number of astute recommendations for conservation, including the importance of regulation, the dissemination of research results, education, and the preservation of critical habitats. Where Rappole effectively identifies the underlying cause of migrant declines, however, I felt that he fell short of identifying one of the most important cures. If the habitats upon which migrants depend are to be preserved, we must assign sustainable economic value to these ecosystems so that they can contribute to the standard of living of the citizens of the countries in which these habitats occur. Nevertheless, Rappole does pro-

vide many useful suggestions to help scientists and public officials contribute to the future health of tropical, and temperate, ecosystems.

The ecology of migrant birds: a neotropical perspective provides a well-rounded and astute summary of the ecology and conservation of neotropical migrants. By being so readable, so thoughtful in its treatment of alternative hypotheses, and so timely in the midst of a critical ecological problem,

this book will positively influence the ideas of many scientists, and nonscientists, interested in avian biology and conservation.

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IS ECOLOGY READY FOR ECOSYSTEM MANAGEMENT?

Samson, Fred B., and Fritz L. Knopf (eds.). 1996. **Ecosystem management: selected readings**. Springer-Verlag, New York. xv + 462 p. \$79.95 (cloth), ISBN: 0-387-94668-3 (alk. paper); \$29.95 (paper), ISBN: 0-387-94667-5 (alk. paper).

Each of the 33 papers in this collection has been published previously in a peer-reviewed journal. This previous review obviates any additional evaluation here, and allows this review to focus on the aims of the editors: “. . . to assist in the dissemination of important literature that can contribute to better informing practicing scientists, resource professionals, and students about the basic issues confronting the development of ecosystem management.” That rather modest goal is achieved, but whether such a “reader” is an efficient way for any interested person to become adequately informed is problematical.

To its credit, the compendium draws broadly from 69 authors in 13 journals, although two thirds of the articles are from *Conservation Biology*, *BioScience*, *Oikos*, and *Ecological Applications*. They are organized into four sections of eight papers each: diversity, ecological processes, biotic integrity, and ecological sustainability. Bracketing several research reports in each section are an overview and a concluding paper. Since none of the papers was written with this in mind, there is a lot of forced fitting. The editors offer only a two-page preface to tell the audience what is going on, and it all seems contrived and uneven. A short paper, “Biodiversity and ecosystem function” by Paul Risser, is used to wrap up the entire volume, but peculiarly, it never mentions ecosystem management! Selections range from important and defining articles by leaders in the field (e.g., Robert Costanza, Peter Vitousek, Eugene Odum, James Karr, C. S. Holling, and Bryan Norton) to interesting but highly specialized research reports on topics such as the desert topminnow and the ground-foraging ant. In length, the papers vary from 2 to 73 pages (the latter is the Holling 1992 opus in *Ecological Monographs*, vol. 62, pp. 447–502 “Cross-scale morphology, geometry, and dynamics of ecosystems.”).

Taken as a whole, the selected readings convey a sobering message: “. . . the ability of science to provide sufficiently powerful tools for the understanding and implementation of ecosystem management . . .” is questionable. Holling, Risser,

and others in this volume advocate a focus on the few dominant processes and key relationships that lead to important interactions between biodiversity and ecosystem manipulations. “Given this enormous complexity, it is easy to see why science frequently fails to provide policy makers with clear advice. . . .” Having invented ecosystem management, with his colleagues, some 20 years ago, Holling now calls for inductive thinking. “Nature is sufficiently surprising that I, at least, am not smart enough to have deduced the patterns described herein and their causes without a framework that allowed nature to point the direction for me” (p. 398).

I wish the editors had written an essay summing up their findings from the considerable work they must have done in assembling the papers; that should not be left to a reviewer. Did they pick and choose to prove a point, or is the situation really this bleak? I suspect the latter but it would be helpful to have an analysis from Samson and Knopf.

An intriguing novel conceptual framework is “Organisms as engineers” by Clive G. Jones, John H. Lawton, and Moshe Shachak. They aver that all habitats on earth are engineered, most without the help of humans, but whether this idea has predictive power is not yet known. Richard J. Hobbs and Laura F. Huenneke conclude in “Disturbance, diversity, and invasion: implications for conservation” that “. . . [W]e must be activists in determining which species to encourage and which to discourage.” But Stuart L. Pimm and John L. Gittleman in “Biological diversity: where is it?” say “We clearly know too little about where the diversity is, why it is there, and what it will become.”

The research reports elicit sympathy and empathy as they document the great practical difficulties in obtaining measurements in the field, validation of models, inability to control or replicate experiments, misfits of fiscal priorities with research needs, non-linear processes, short incomplete historical records, and finding indicator species. Little of the research selected was at management scales of time and space, nor was it originally designed to directly support ecosystem management. Many of the papers lament the unpredictability of perturbations of biodiversity from exotic species.

Ecosystem management is, however, more than biodiversity. In fact, Paul L. Angermeier and James R. Karr argue in “Biological integrity versus biological diversity as policy di-

rectives: protecting biotic resources," goals of biological conservation and restoration should be based on integrity rather than species. Ecosystem management has to do with the sustainability of multiple uses and harvested production, as well. Moreover, it is a social construct. Implementation includes stakeholders, partnering, cultural heritage, core values, and economic self sufficiency. It is necessarily adaptive, and heavily dependent on monitoring of ecological condition, because of irreducible uncertainties. The non-natural science aspects of ecosystem management have politicized it, and also have led to taking for granted that the science will be there when needed. *Ecosystem management: selected readings* warns that this assumption is ill-founded.

Unavoidably perhaps, the papers are dated—all but one were published in 1994 or earlier. The compilation itself was probably in press for a year, and with usual journal prepublication delays of at least a year, the papers represent data and thinking of about four years ago. That was when ecosystem management, as a paradigm in the U.S., just began to develop, although some scattered attempts were made ear-

lier, such as in the greater Yellowstone area. I ran a search in the University of Virginia library in preparing this review and turned up 87 journal articles published in the last 12 months on ecosystem management. Important literature relevant to the concept was not available to this volume, e.g., two papers that appeared in *Ecological Applications* (1996, volume 6) and a practical guide from The Nature Conservancy (Conserving biodiversity on military lands: a handbook for natural resource managers. 1996. The Nature Conservancy, Arlington, Virginia).

Thus I would suggest buying this book only if one does not have access to a graduate research library, and then only to have a snapshot at the beginning of this rapidly growing field. We may hope that future readers on ecosystem management will record the results of a well-funded research program, planned and carried out to undergird ecosystem management with scientific understanding.

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NITROGEN TRANSFORMATIONS IN ANTHROPOGENIC GRASSLANDS

Whitehead, D. C. 1995. **Grassland nitrogen**. CAB International, Oxon, United Kingdom. xv + 397 p. \$90.00, £49.95, ISBN: 0-85198-915-2.

Basic ecological research in soil-plant-animal interactions and in land-atmosphere exchanges of nutrients has, until recently, lagged behind research conducted with agricultural production as the focus. In this regard, *Grassland nitrogen* may serve as a valuable source of information to ecologists that may not otherwise have a good grasp of literature published in journals such as *Agronomy Journal*, *Journal of Agricultural Science*, *Fertilizer Research*, *Grass and Forage Science*. This book is clearly oriented towards agricultural and environmental sciences, and these are its stated audiences. A second aspect of the scope of the book is the primary focus on anthropogenic grassland in climates that would otherwise be forest. The first figure shows North American grasslands occupying areas east of the Mississippi River, the Rocky Mountains, and the far west coast; semiarid to subhumid grasslands of the Great Plains and grasslands of southwestern U.S. are not included. Europe and New Zealand are considered areas of temperate grassland. Although the preface and introductory chapter clearly state the scope, the title of the book can easily be misleading to ecologists who may be more likely to think of anthropogenic grasslands as "seeded pasture." Much of the research cited in the book is from work conducted in rye grass/clover swards in the U.K., but the author has made an effort to extend this base to include research from other systems.

Given the above potential limitations of setting and scope, there is much in this book that would be of interest to ecologists, particularly those working in areas of plant-animal interactions, trace gas fluxes, and nutrient enrichment. Chapter 2 is a basic, but comprehensive, examination of uptake of nitrogen by plants, and effects on all aspects of growth. As with much of the book, comparisons are made across a range of fertilizer treatments, providing perspectives across availability gradients. Two chapters provide a good overview of the role of herbivores in nitrogen cycling. The emphasis is on cattle and sheep in sown pastures, with only cursory mention of the large amount of research conducted in native grasslands. For those working in native grasslands, there are many relevant, useful data and references that I have never seen cited in ecological literature. Coverage on excreta is broad and intensive, but is very weak on consumption and digestion. Effects on the animal is not an emphasis. Three chapters deal with transformations of nitrogen in the soil, and two chapters with volatilization. Emphasis is on fertilizer, grazing, and plowing effects. Several chapters have sections on environmental impacts. Five of the 16 chapters are on uses and effects of fertilizers and their interactions with abiotic and biotic factors and other nutrients. This book could be titled "almost everything you ever wanted to know about U.K. pastures," and must be an extension agent's dream in that country. The last chapter briefly presents nitrogen balances in cut, in heavily grazed and intensively managed pastures, and in "rough" or native grasslands, but there is little attempt at synthesis.

The text is sometimes very densely packed with facts and numbers, but good organization and flow throughout make this a book that can easily be read by students, managers,

and researchers. Unlike many scientific books, no prior knowledge of a particular term or concept is necessary, yet there is sufficient depth and detail in the science that is presented. Figures and tables are simple and to the point, but there were many places where additional ones could have been useful.

This is not a book that most research ecologists interested in native-grassland nitrogen would want to purchase, but one that most would want to at least look through and have available in the library. It would be a must for ecologists and plant and animal agriculturalists, managers, and advisors working in intensively managed sown pastures, particularly in many

parts of Europe. It is a fine example of a blending of basic and applied research placed in a format understandable to even producers—one that I would consider handing to many western U.S. ranchers who are highly skeptical about why one would ever want to measure something like ammonia volatilization.

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BOOKS AND MONOGRAPHS RECEIVED THROUGH AUGUST 1996

- Beans, Bruce E. 1996. **Eagle's plume: the struggle to preserve the life and haunts of America's bald eagle.** Scribner/Simon and Schuster, New York. 318 p. \$25.00, ISBN: 0-684-80696-7.
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- Davis, Wade. 1996. **One river: explorations and discoveries in the Amazon rain forest.** Simon and Schuster, New York. 537 p. \$27.50, ISBN: 0-684-80886-2.
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