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ECOLOGICAL SCIENCE FOR LAWYERS: A BOOK REVIEW

Professor Fred P. Bosselman*

Richard O. Brooks, Ross Jones & Ross A. Virginia, *Law and Ecology: The Rise of the Ecosystem Regime* (Ashgate Pub. Ltd. 2002).

Lawrence B. Slobodkin, *A Citizen's Guide to Ecology*
(Oxford U. Press 2003).

Michael L. Rosenzweig, *Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise* (Oxford U. Press 2003).

I. INTRODUCTION

People who write in law reviews have a lot to say about ecology. During the five-year period of 1998-2002, a LEXIS search of all law reviews for "ecolog!" brings up over 3000 references. However, only a select few authors seem to read much ecological literature. For example, a search of the LEXIS "U.S. Law Reviews and Journals, Combined" database for the five-year period beginning January 1, 1998 and ending December 31, 2002 found an average of less than 20 law review articles per year citing to any of the 63 scientific journals of ecology that have names sufficiently distinctive to enable a word search.¹

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¹ The Journals "Ecology" and "Ecosystems" had names too generic to be found by a word search. In addition, scientific articles on ecological subjects may be found in journals that cover many different scientific fields, such as "Nature" and "Science," but these journals also have titles too generic to be found by a word search. A list of the 63 journals searched showing the number of law review articles citing to each journal, and a copy of the text of the search, which was conducted on January 22, 2004, are on file with the *Southeastern Environmental Law Journal*.

This lack of scientific content may be the result of a dearth of scientific ecological books suitable for use as teaching materials in law schools or for background reading for environmental lawyers. It takes only a few minutes in front of the shelves labeled "ecology" at your local bookstore to realize that most of the books are heavy on shock value and light on science.

It was thus a pleasure to find three books that came on the market in 2003² that combine good science and readability at a level that should be attractive to lawyers, law educators, and law students. In combination, these three books provide an excellent foundation for a law school course on ecological science and the law or for a self-study course for environmental lawyers. Each book is written by capable people who approach the issues from very different perspectives. In combination, they provide a fine introduction to some of the many exciting ideas permeating the field of scientific ecology.

II. LAW AND ECOLOGY: THE RISE OF THE ECOSYSTEM REGIME

Richard Brooks, the lead author of *Law and Ecology: The Rise of the Ecosystem Regime*,³ has been a professor at the Vermont Law School since 1978.⁴ His co-authors, Dr. Ross A. Virginia⁵ and Dr. Ross Jones,⁶ teach in the Environmental Studies program at Dartmouth College. This book, unlike the other two, is written more in the style of a textbook for students than as a trade book and appears to be aimed at students at both the undergraduate and law school levels.

A key theme running through the book is the growth of institutions that address both legal and ecological issues at an ecosystem level.

² Although *Law and Ecology: The Rise of the Ecosystem Regime* was copyrighted 2002, the author was not able to find a copy to buy until the spring of 2003.

³ Richard O. Brooks, Ross Jones & Ross A. Virginia, *Law and Ecology: The Rise of the Ecosystem Regime* (Ashgate Pub. Ltd. 2003).

⁴ Vermont Law School, *Media Outreach Center, Professor Richard O. Brooks – Expertise* <http://www.vermontlaw.edu/media/emp_media_expertise_template.cfm?doc_id=417> (last accessed June 1, 2004).

⁵ Dr. Ross A. Virginia is Albert Bradley Third Century Professor in the Sciences at Dartmouth specializing in soil ecology <<http://www.dartmouth.edu/~envs/faculty.shtml#ross>> (last accessed June 1, 2004)

⁶ Ross Jones is a visiting assistant professor with degrees in both ecology and law <<http://www.dartmouth.edu/~envs/faculty.shtml#jones>> (last accessed June 1, 2004).

Brooks et al., suggest that the joint efforts of groups such as environmental organizations, government agencies, and resource user groups have succeeded in establishing institutions that operate at a large geographic scale based on boundaries that are natural rather than political. They define this as “ecosystem” scale.⁷ They see this development as one of the most important influences that ecology has had on the law and suggest that although relatively few existing environmental laws focus specifically on the ecosystem scale, other environmental laws are being retrofitted or redirected to regulation at that scale.⁸

The authors provide a quick summary of the traditional specialties within ecology.⁹ The importance of the mathematical side of ecology is recognized but not explained in detail. They emphasize, however, that it is new computing and data-gathering technologies that have made it possible to apply ecology at the large scales necessary to resolve issues at the ecosystem level.¹⁰ The more traditional study of interacting individuals of a single species – “population ecology” – is contrasted with the newer, larger scale research with which the book deals.¹¹

It is “applied ecology,” not theoretical ecology, which is the major focus of the book. The authors divide applied ecology into “two broad categories based upon both the objects that are being managed and the ethical basis for the management decision.” They label the two categories “ecosystem management” and “conservation biology.” The former is characterized as being utilitarian and anthropocentric while the latter is based on the assumption that biodiversity has inherent value beyond its value to humans.¹² The book includes concise summaries of a number of current examples of ecosystem management, including the programs to manage Chesapeake Bay and the Everglades,¹³ and of conservation biology, including a brief discussion of the Endangered Species Act and

⁷ Brooks, *supra* n. 3, at 23-25.

⁸ *Id.* at 35.

⁹ *Id.* at xiv-xv (the book is described as the first in a series of future books, some of which will cover particular ecological fields in more detail).

¹⁰ *Id.* at 17.

¹¹ See e.g. *id.* at 11, 377.

¹² *Id.* at 22 (this classification reflects the conservation vs. preservation analysis popularized by Samuel Hays. Samuel Hays, *Conservation and the Gospel of Efficiency* (Harv. U. Press 1959). See also Roderick Nash, *Wilderness and the American Mind* (Yale U. Press 1967)).

¹³ *Id.* at 261-279.

more extended discussions of the ways that ecological ideas are being applied to the national forests and the marine fisheries.¹⁴

The bulk of the book is a historical analysis of how public opinion grew “to support the notion that the duty of citizens and government is to protect ecosystems, and to regulate property, industry and technology in order to do so.”¹⁵ The period before 1960 is dealt with succinctly in a single chapter that explains how the ideas of 19th century thinkers, such as Muir and Marsh, blended with the legal ideas of the progressive era to culminate in the natural resource planning activities of the New Deal in the 1930s. Paralleling this growth of public policy was the increasing acceptance of ecology as an important branch of the biological sciences.¹⁶

The growing concern about DDT in the 1960s is described as the culmination of broad historical changes in American public culture that made people aware that both public health and resource usage were issues that needed to be addressed at levels higher than local government.¹⁷ At the same time, Eugene Odum was taking scientific ecology to a higher level by “plac[ing] the ecosystem at the center of the study of nature.”¹⁸ Federal environmental laws passed in the 1970s, however, largely rejected ecological solutions in favor of technological solutions for pollution of particular media (e.g. air, water).¹⁹

The authors see greater recognition of ecology in some of the place-based state legislation of the 1960s and 1970s.²⁰ They point to the New Jersey Pinelands Act²¹ and the Lake Tahoe Regional Planning Compact²² as examples of legislation that use an ecological perspective to study a particular region.²³ In contrast, laws like the Clean Air Act²⁴ and the Resource Conservation and Recovery Act²⁵ emphasized technology-based approaches and downplayed potential ecological approaches to pollution

¹⁴ *Id.* at 286-313.

¹⁵ *Id.* at 50 (the tone of the book is quite optimistic).

¹⁶ *Id.* at 62-74.

¹⁷ *Id.* at 89.

¹⁸ *Id.* at 90.

¹⁹ *Id.* at 120-122.

²⁰ *Id.* at 134.

²¹ N.J. Stat. § 13:18A (2004).

²² Pub. L. No. 91-148, 83 Stat. 360 (1969).

²³ *Id.* at 134-142.

²⁴ 42 U.S.C. §§ 7401-7671Q (2004).

²⁵ 42 U.S.C. §§ 6901-6992k (2004).

problems.²⁶ The authors cite three early federal laws that appeared to embody ecological concepts, the National Environmental Policy Act,²⁷ the Coastal Zone Management Act,²⁸ and the Great Lakes Water Quality Agreement,²⁹ but they also recognized that these laws did not always live up to their potential.³⁰ Other laws dealing with forestry, national parks, and endangered species were ecologically retrofitted as “the administrators of these laws gradually but grudgingly realized the relevance of ecology to their missions.”³¹

The integration of law and ecology culminated in the development of earth systems science and the recognition of its importance by the international community in developing legal solutions to global problems:

The discipline of Earth System Science seeks to understand the coupling and functioning of global systems that include the land, oceans and the atmosphere. This requires an understanding of the component parts and their interactions, how they have evolved and currently function, and how the earth’s systems will respond naturally and in response to human activities over short to long time scales.³²

The authors see earth systems science as a basis for a new “experimental jurisprudence” in which the scientific method is incorporated into legal process.³³

As the book progresses to the 1990s, the authors develop case studies of the use of earth systems science to address three global problems: acid rain, ozone depletion, and climate change. The authors recognize that the fingerprints of ecology are not so easy to find in the regulations addressing each of these problems. In each example, although the resulting regulations were primarily based on the work of scientists, they do not incorporate the language or concepts of ecology.³⁴ They contend,

²⁶ *Id.* at 123-26, 144-45.

²⁷ 42 U.S.C. §§ 4321-4347 (2004).

²⁸ 16 U.S.C. §§ 1451-1465 (2004).

²⁹ 33 U.S.C. § 1268 (2004).

³⁰ *Id.* at 155-85.

³¹ *Id.* at 193.

³² *Id.* at 345.

³³ *Id.* at 349.

³⁴ *Id.* at 231.

however, that the “insights of ecology” were used in the initial research on these three problems, and that this research played a key role in program development.³⁵

At this point, a reader may feel that the authors are giving ecologists more credit than they are due. The ecologists’ role in the early development of the acid rain program is easy to demonstrate. Regarding climate change, however, although ecologists are now playing a key role in answering questions such as the extent of carbon storage in forests and oceans, their work has been hampered because they lack the kind of baseline data that would have been available if they had focused on the problem earlier.³⁶ Furthermore, the book cites no substantial contribution by ecologists to ozone hole research.³⁷ Nevertheless, global interdisciplinary research that includes ecologists appears to be the wave of the future.³⁸

A slightly annoying feature of the book is its authors’ insistence on using common terms they define in novel ways.³⁹ The word “regime” is used in the book’s subtitle, “the rise of the ecosystem regime,” and elsewhere throughout the book, in a way that may confuse people unfamiliar with the work of Dartmouth political scientist Oran Young, who uses the term “resource regimes” to define “social institutions that serve to order the actions of those interested in the use of various natural

³⁵ *Id.* at 257.

³⁶ See Jocelyn Kaiser & Karen Schmidt, *Coming to Grips with the World’s Greenhouse Gases*, 281 Sci. 504 (1998).

³⁷ See Brooks, *supra* n. 3, at 231-61 (Throughout most of the book, the authors use the word “ecology” in its scientific sense. The word “ecology” in popular usage clearly seems to signify any situation in which two or more different things interrelate); see Arran E. Gare, *Postmodernism and the Environmental Crisis* 86-96 (Routledge 1995).

³⁸ One prominent example is the growing interest by the National Science Foundation in funding large-scale, long-term ecological research. See Jocelyn Kaiser, An Experiment for All Seasons, 300 Sci. 624 (2001); Sonya Senkowsky, NEON: Planning for a New Frontier in Biology, 53 BioScience 456 (2003).

³⁹ For example, the authors use the term “new ecology” to define a modern tendency to study ecology at multiple levels of organization, while pointing out in a footnote that this term is more commonly used to describe the recognition that “most ecosystems, populations, and communities exist in a state of disequilibrium.” Brooks, *supra* n. 3, at 265 & n. 21, 281.

resources.”⁴⁰ Given the more common employment of the term “regime” to connote dictatorial rule, this specialized usage is unfortunate.⁴¹

The book’s strengths, however, far outweigh its semantic problems. By providing a parallel history of the development of ecological ideas and the use of those ideas in the legal system, the authors create a useful context in which to view the interaction of the two disciplines. The book’s history ends with the end of the 20th century, and we will look forward to forthcoming books in the series that will analyze how this relationship progresses.

III. *A CITIZEN’S GUIDE TO ECOLOGY*

*A Citizen’s Guide to Ecology*⁴² is the work of Dr. Lawrence B. Slobodkin, the longtime chair of the ecology and evolution program at the State University of New York at Stony Brook. Although his primary research interest has been small freshwater invertebrates, he has written extensively about the application of ecological and evolutionary ideas on a larger scale.⁴³

Slobodkin says he has written his book because of his dissatisfaction with the sensationalist trash he sees on the ecology shelves in the bookstores.⁴⁴ Accordingly, his goal is to “enable readers to distinguish serious ecology from mystical visions of nature provided by well-meaning pantheists as well as nonsense mouthed by self-appointed leaders for personal aggrandizement or from a desire to hear their own voices.”⁴⁵

Furthermore, he believes that ecologists should take a strictly scientific perspective in giving advice on ecological problems; he observes that

⁴⁰ Oran R. Young, *Resources Regimes: Natural Resources and Social Institutions* 15-16 (Univ. Cal. Press 1982).

⁴¹ A search of the NEXIS news group for the 90 days up to September 4, 2003, for “regime w/3 ecosystem!” yielded one citation, which was not actually on point. A search for “regime w/3 dictat!” yielded 532 citations. A search for “regime w/3 hussein” could not be completed because it would have produced over 3,000 citations.

⁴² Lawrence B. Slobodkin, *A Citizen’s Guide to Ecology* (Oxford Univ. Press 2003).

⁴³ See Stony Brook U., Dept. of Ecology & Evolution, *Selected Pub. of Lawrence B. Slobodkin* <<http://life.bio.sunysb.edu/ee/people/slobodkpubs.html>> (last accessed June 1, 2004).

⁴⁴ Slobodkin, *supra* n. 42, at 13-15.

⁴⁵ *Id.* at 20.

How we argue about ecology is often as important as the substance of our arguments. There is a temptation to focus on winning the argument. The issues of ecology are too important for that. If you happen to win an important argument by using what you know to be bad science, in the long run you will have damaged the future of science itself. You will have destroyed the authority of good science, and on some future occasion opponents may use equally specious science to destroy your position.⁴⁶

He also appreciates that scientists will not, and should not, always have the final word. He suggests that ecologists must recognize that the scientific issues are overlain with complex philosophical, economic and social values that need to be considered, and that the resources available to address ecological issues are limited.⁴⁷ "Ethical problems must involve triage. The relative value of competing needs must be decided... through public discussion. That is why applied ecology cannot avoid being political."⁴⁸

The book is written in a style that makes it easy to read. He avoids overuse of technical jargon, and illustrates ecological concepts with reference to familiar fact situations, but he does not talk down to the reader. He begins with a discussion of two ecological processes of global scope (the water cycle and the energy cycle), and in a later chapter discusses the relation of the carbon cycle to global warming, however, much of the book deals with ecology at the population and community level.⁴⁹ "With the exception of some changes in the atmosphere and in

⁴⁶ *Id.* at 209.

⁴⁷ *Id.* at 203 ("Solving ecological problems involves governmental activity, major financial commitment, and sometimes even international accords, or, failing that, wars. While it is not possible to deal with all ecological problems, the world will be tragically different if no attempt is made to deal with any of them").

⁴⁸ *Id.* at 204. For a variety of views on the application of triage to ecological issues, see *The Importance of Species: Perspectives on Expendability and Triage* (Peter Kareiva and Simon A. Levin, eds., Princeton U. Press 2003).

⁴⁹ Slobodkin is less comfortable with the use of "ecosystem" as a unifying concept than are Brooks et al. He calls the earth the only near-perfect ecosystem because it is isolated in space. We can define "not quite perfect" ecosystems, but "their borders are fuzzy and leaky." *Id.* at 52. For other commentary on the contemporary use of "ecosystem," see S.T.A. Pickett & M.L. Cadenasso, *The Ecosystem as a Multidimensional Concept: Meaning, Model, and Metaphor*, 5 *Ecosystems* 1 (2002);

water quality, most practical problems of ecology are on a relatively small scale.”⁵⁰

He discusses community ecology by focusing upon the annual flood of the Amazon River and by summarizing the ecological processes that ensue in the flooded forest that subsequently becomes a lake for weeks on end.⁵¹ Other communities, he suggests, are “more or less extreme variants of lakes.”⁵² He warns, however that even well-defined lakes do not have sharp community boundaries because lakes are greatly affected by ecological processes that take place deep in their watersheds, such as in the mangrove communities of the Florida Everglades⁵³ or the coastal bays near Long Island and San Francisco.⁵⁴

Population ecology is introduced by discussing the processes by which populations persist over time, such as survival, reproduction, and dispersal. Here Slobodkin introduces a bit more technical treatment of the way ecologists analyze populations, using such concepts as reproduction rates and survivorship curves. Of the three books, this one provides the best introduction to the way that ecologists look at populations and communities.⁵⁵

Regarding biodiversity, he adopts the position that solutions must be approached at the local level because “there is no simple theory of species diversity. The continued existence of any species depends on a broad series of requirements, different for each species.”⁵⁶ He argues persuasively for the preservation of biodiversity because each species is a masterpiece left to us by the past that has endured one crisis after another, and it is horrible that the history of any species should be ended by human activity. However, he feels that science alone cannot support the need to preserve every species. He is critical of Paul Ehrlich’s famous analogy that the loss of any species is like losing one of the rivets on an airplane, so that one missing rivet may not be a problem, but as the loss of rivets

Robert V. O'Neill, *Is It Time to Bury the Ecosystem Concept? (With Full Military Honors, of Course!)*, 82 *Ecology* 3275 (2001).

⁵⁰ Slobodkin, *supra* n. 42, at 101.

⁵¹ *Id.* at 69-70.

⁵² *Id.* at 70.

⁵³ *Id.* at 83.

⁵⁴ *Id.* at 96.

⁵⁵ *Id.* at 101-127.

⁵⁶ *Id.* at 138.

increases a point may come when the plane crashes.⁵⁷ "But there is no airplane," Slobodkin says, only "loosely connected piles of parts."⁵⁸

He also questions the extreme positions some environmentalists have taken on the need to prevent and destroy invasive species. We cannot assign good or bad intentions to any species, he argues, nor can we assign moral purpose to natural events. We need to recognize the difference between those non-indigenous species that are beneficial to humans, or at least harmless to indigenous species, and those that have existing or potentially harmful impacts on biodiversity or human health.⁵⁹

One of the book's strengths is its ability to combine readable introductions to ecological concepts with cautionary reminders that ecology is not a self-sufficient answer to all of our problems, such as the following passage:

Many ecologists now believe that certain species, certain landscapes, and certain rivers and oceans cry out for treatment of some sort. Ecologists claim they are the ones to make the triage decisions and to provide the treatments. The truth of this statement is a center of concern. There is an enormous range of opinions about what is or is not to be done in any particular case. Not all opinions can be correct.⁶⁰

Although he is more pessimistic in tone than Brooks et al, Slobodkin strongly advocates continued efforts to address ecological problems on both large and small scales. All three of the books stress this need to study ecological issues at a variety of scales of space and time, but Slobodkin clarifies this important point particularly well. The book accomplishes its objective of demonstrating the importance of ecological issues without exaggerating either the dangers or the prospects for solutions.

⁵⁷ Paul R. Ehrlich and Anne H. Ehrlich, *Extinction: The Causes and Consequences of the Disappearance of Species* (Random House 1981).

⁵⁸ Slobodkin, *supra* n. 42, at 144.

⁵⁹ *Id.* at 144-153.

⁶⁰ *Id.* at 203.

IV. WIN-WIN ECOLOGY

The author of *Win-Win Ecology*,⁶¹ Dr. Michael L. Rosenzweig, is another highly regarded senior member of ecological academia. Dr. Rosenzweig is professor of ecology and evolutionary biology at the University of Arizona, where he specializes in large-scale biodiversity research.⁶² He is also the editor of the journal *Evolutionary Ecology Research* and the author of one of the leading books on biodiversity theory.⁶³

Having made his scientific reputation at the macroecological level, it may surprise some of his readers that he has written a book arguing that ecology should be applied at the lowest practical level. However, in supporting that position, he keenly illustrates the way that large-scale theoretical ecology can lead to practical local solutions for real-life problems.

Rosenzweig focuses on the ecological problem of the loss of biodiversity. He clearly believes that biodiversity is not only an *important*, but a *preeminent*, ecological objective whose foundations are not only utilitarian and scientific but also moral and religious. The Bible, he says, “commands us to let all Earth’s creatures be ‘fruitful and multiply.’”⁶⁴

I suspect that the title *Win-Win Ecology* was a creation of Oxford’s editorial staff, because the phrase rarely appears in the text.⁶⁵ Rosenzweig himself had originally titled the book *Reconciliation Ecology*, a term he

⁶¹ Michael L. Rosenzweig, *Win-Win Ecology: How the Earth’s Species Can Survive in the Midst of Human Enterprise* (Oxford U. Press 2003).

⁶² U. of Ariz., Dept. of Ecology & Evolutionary Biology, Faculty Members: Michael L. Rosenzweig, Prof. of Ecology & Evolutionary Biology, <<http://eebweb.arizona.edu/faculty/mlro/>> (last accessed June 1, 2004).

⁶³ Michael L. Rosenzweig, *Species Diversity In Space and Time*, (rev. ed., Press Syndicate of the U. of Cambridge 1996).

⁶⁴ Rosenzweig, *supra* n. 61, at 42. Few ecologists would disagree with the importance of biological diversity, but it is somewhat surprising that Rosenzweig does not bother to defend the preeminent status he attaches to it as opposed to, for example, the maintenance of large-scale ecological processes emphasized by Slobodkin.

⁶⁵ He does say that “reconciliation ecology transforms the zero-sum game of competition into a game that humans and nature alike can win.” Rosenzweig, *supra* n. 61, at 10.

uses throughout the book.⁶⁶ While the connotations of the two terms are fairly similar, “reconciliation” more correctly conveys the author’s moral point of view than the utilitarian phrase “win-win.”

Like Brooks et al, he emphasizes applied ecology, which he divides into three categories: (1) reservation ecology; (2) restoration ecology, and (3) reconciliation ecology.⁶⁷ He emphasizes that the protection of natural reserves and the restoration of natural areas are important objectives, and that he is seeking not to replace them, but to supplement them with his new term “reconciliation ecology,” which encompasses the “science of inventing, establishing, and maintaining new habitats to conserve species diversity in places where people live, work and play.”⁶⁸ He additionally seeks to “reconcile human uses of our planet with those of other species.”⁶⁹

Rosenzweig uses some forty pages of the eighth chapter, “Tyranny of Space,” to explain the theoretical basis for his underlying argument that reserves and restored natural areas will not be sufficient to prevent a growing wave of extinctions. In brief, he argues that at the global scale there is a steady ratio of species diversity to habitable area; and if the growth of the human population reduces the area habitable for other species it will not only increase the rate of extinctions but decrease the formation of new species needed to balance the diversity equation.⁷⁰ The argument is both technically proficient and easily readable and provides the reader with a good introduction to macroecological science.

The bulk of the book, however, describes practical examples of human activities that have increased the opportunities for humans and other species to live together in harmony. Rosenzweig finds interesting

⁶⁶ On his current web site, Rosenzweig still emphasizes “reconciliation.” See Michael L. Rosenzweig, *The Careful Foot* <<http://evolutionary-ecology.com/winwin>> (last accessed June 1, 2004).

⁶⁷ Like Brooks, Kaiser, and Senkowsky, *supra* nn. 38-39, Rosenzweig is not afraid to create his own terminology.

⁶⁸ Rosenzweig, *supra* n. 61, at 7. Only the terminology is new, of course, and many practicing ecologists who have long been engaged in field work at the community level may resent the fact that a highly theoretical ecologist acts as the originator of the concept. However, as the creation of the term “biodiversity” itself illustrates, spin may achieve ecological objectives. See David Takacs, *The Idea of Biodiversity: Philosophies of Paradise* (Johns Hopkins U. Press 1996).

⁶⁹ Rosenzweig, *supra* n. 61, at 7.

⁷⁰ *Id.* at 101-141 (noting that this argument was made at greater length in his more academically-oriented book, Rosenzweig, *Species Diversity in Space and Time*, *supra* n. 63).

examples from all continents, and includes both deliberate strategies (e.g. bluebird-box building)⁷¹ and lucky accidents (e.g. endangered crocodiles at a nuclear power plant).⁷² Some of his examples are regional in scale (e.g. protection of longleaf pine in the southeastern states)⁷³, but many are local, one-of-a-kind projects, such as a salt marsh in Eilat built with construction debris.⁷⁴

Rosenzweig is not a lawyer, but his intuition about the operation of laws is very perceptive. He recognizes the need for national laws to address problems of wide-ranging scope, such as the protection of migrating birds and carnivores with large territories, and the control of invasive species.⁷⁵ However, he fears that the administration of conservation law may degenerate into a series of "thoughtless reflex actions" that detract from the overall objective.⁷⁶ As an example, he cites the Endangered Species Act's inhibition of experimental ways to promote species recovery.⁷⁷

He advocates projects to harbor wildlife at the lowest geographical level possible, analogizing to the European Union principle of subsidiarity, under which power is transferred to the European level only if the objective cannot be achieved at a lower level.⁷⁸ As an admirer of family farms, he is particularly critical of modern chemical-dominated agriculture;⁷⁹ this view is seen when he states, "[t]raditional ways of exploiting the Earth, often associated with having less cash, tend to be sustainable and harbor many native species."⁸⁰

⁷¹ *Id.* at 71-74.

⁷² *Id.* at 86-89.

⁷³ *Id.* at 28-37.

⁷⁴ *Id.* at 28-37, 47-50.

⁷⁵ *Id.* at 168.

⁷⁶ *Id.* at 167.

⁷⁷ *Id.* at 36-37 (discussing how landowners needed the U.S. Fish and Wildlife Service's "safe harbor" program to overcome landowners' fears about attracting rare species to their lands).

⁷⁸ *Id.* at 166.

⁷⁹ *Id.* at 50-68. For another recent book of interest on this topic, see Harold Brookfield, et al., *Cultivating Biodiversity: Understanding, Analysing and Using Agricultural Diversity* (ITDG Pub. 2002).

⁸⁰ Rosenzweig, *supra* n. 61, at 176. (citing with approval Gretchen Daily's recent work on what she calls "countryside biogeography"); see generally Gretchen C. Daily & Katherine Ellison, *The New Economy of Nature: The Quest to Make Conservation Profitable* (Island Press 2002). His concern, nevertheless, is that efforts to prove that

Although Rosenzweig supports the creation of large-scale wildlife reserves, he emphasizes that the objectives of creating such reserves should be reexamined. Reserves need active management, particularly in light of climate change, and he notes, “[w]e must give up romantic notions of reserves as wilderness.”⁸¹ Reserves should be used to protect the relatively small proportion of species that are unable to coexist with humans, and to do so we may need to focus management of the reserves exclusively on those few species, not on those that are common elsewhere. He argues, “[t]o save the most species, we may need to eliminate some from our reserves. A radical notion? Yes. But in difficult times we may need to consider radical answers.”⁸²

V. CONCLUSION

Read together, these three books provide a readable introduction to current applications of ecological science; however, they are not the only recent books on ecology worth reading by lawyers who are interested in applied ecology. Two recent books are devoted particularly to the use of ecological science in natural resource management. Guy McPherson and Stephen DeStefano have written a book intended to bring federal land managers up to date on modern ecological ideas,⁸³ while John Bissonette and Ilse Storch have edited a recent volume of interesting case studies and theoretical analysis of the way that the theories of “landscape ecology”⁸⁴ can be applied to the management of resources.⁸⁵ Resource managers themselves have also written interesting descriptions of the use of ecology

biodiversity is profitable may not only be based on the wrong objective, but may be hard to prove. Rosenzweig, *supra* n. 61, at 39-41.

⁸¹ *Id.* at 8.

⁸² *Id.* at 175.

⁸³ Guy R. McPherson & Stephen DeStefano, *Applied Ecology and Natural Resource Management* (Cambridge U. Press 2003).

⁸⁴ Landscape ecology is the study of the interrelationship of organisms with the geomorphological characteristics of the areas they occupy. Michael Allaby, *A Dictionary of Ecology* 233 (2d ed., Oxford U. Press 1998).

⁸⁵ John A. Bissonette & Ilse Storch, eds., *Landscape Ecology and Resource Management: Linking Theory with Practice* (Island Press 2003). See also Robert A. Askins, *Restoring North America's Birds: Lessons from Landscape Ecology* (Yale U. Press 2000).

in their work, especially Massachusetts Audubon's William Holland Drury.⁸⁶

The application of ecological research to practical solutions for the protection of biodiversity is the subject of another recent book by Tim O'Riordan and Susanne Stoll-Kleeman.⁸⁷ The controversial issue of the extent to which biodiversity affects ecological processes is covered in an important series of papers edited by Ann Kinzig, Stephen Pacala, and David Tilman.⁸⁸ The sophisticated science writers David Quammen and Scott Weidensaul have recently written two very readable treatments of biodiversity.⁸⁹ However, for serious research on biodiversity, the five-volume treatise edited by Simon Levin is essential.⁹⁰

The application of large-scale ecology is interrelated with the other environmental sciences that operate on a global scale. Particular attention should be paid to the recent report of the National Research Council that discusses the need for more interdisciplinary action to resolve global environmental problems.⁹¹ Environmental lawyers have an exciting assignment in keeping abreast of rapidly changing scientific developments. Interestingly, scientists in the various fields of environmental science increasingly recognize the need to communicate with scientists in other disciplines, and consequently they seem to be writing in a language more accessible to lawyers.

⁸⁶ William Holland Drury, Jr., *Chance and Change: Ecology for Conservationists* (John G. T. Anderson ed., U. of Cal. Press 1998).

⁸⁷ *Biodiversity, Sustainability and Human Communities: Protecting Beyond the Protected* (Tim O'Riordan & Susanne Stoll-Kleemann eds., Cambridge U. Press 2002).

⁸⁸ *The Functional Consequences of Biodiversity: Empirical Progress and Theoretical Extensions* (Ann P. Kolzig et al. eds., Princeton U. Press 2002). See also *Biodiversity and Ecosystem Functioning: Synthesis and Perspectives* 3, 11 (Michel Loreau et al eds., Oxford U. Press 2002); Brian A. Maurer, *Is Biodiversity Important in Ecosystems?*, 84 *Ecology* 1074 (2003).

⁸⁹ David Quammen, *Monster of God: The Man-Eating Predator in the Jungles of History and the Mind* (W. W. Norton 2003). Scott Weidensaul, *The Ghost with Trembling Wings: Science, Wishful Thinking, and the Search for Lost Species* (N. Point Press 2002).

⁹⁰ *Encyclopedia of Biodiversity* (Simon A. Levin ed., Academic Press 2001). See also *Precious Heritage: The Status of Biodiversity in the United States* (Bruce A. Stein et al. eds., Oxford U. Press 2000); Brian Groombridge and Martin D. Jenkins, *World Atlas of Biodiversity: Earth's Living Resources in the 21st Century* (U. of Cal. Press 2002).

⁹¹ National Research Council, *Grand Challenges in the Environmental Sciences* (Natl. Acad. Press 2001).

