## **Book Reviews**

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## Do we need a textbook in tropical ecology?

Kricher, John. 2011. **Tropical ecology.** Princeton University Press, Princeton, New Jersey. viii + 632 p. \$85.00, ISBN: 978-0-691-11513-9 (alk. paper).

Key words: ecology; John Kricher; textbook; tropical ecology; tropics.

John Kricher starts the Introduction of his new textbook *Tropical ecology* with the question: "Is tropical ecology unique within the study of ecology?" With several great textbooks in ecology already in the market, Kricher's question essentially echoes my own of whether or not tropical ecology needs its own textbook. Having taught general ecology and a field course in tropical ecology, I read Kricher's textbook with this question in mind.

Tropical ecology has 15 chapters and is broadly organized into four sections: a large section dealing with biodiversity in tropical rain forests, a section on productivity and nutrient cycling, a section on other ecosystems in the tropics, and a final section on human ecology in the tropics, including relevant issues in conservation. The first chapter gives an overview of tropical ecology, providing a nice background on the rich history of tropical fieldwork including that of Darwin, Wallace, and Humboldt. It provides a useful synopsis of the advances in tropical ecology over the years. It further gives a nice overview of all the biomes around the world, and a wonderfully succinct and accessible summary of the climatic processes that create the global diversity in biomes.

Chapters 2 to 8 are dedicated to exploring biodiversity in tropical rain forests, tackling the general question of why biodiversity is much richer in rain forests than anywhere else on the planet and the ecological consequences of having such diverse communities. With respect to the evolution and ecology of tropical diversity, Kricher deals with this question nicely by starting with biogeography and the evolutionary processes that generate diversity in general. This summary is rather brief, and is clearly intended for students with a basic background in evolutionary and ecological theory. It is, however, enough to provide the framework for the next few chapters. The next chapter describes the physical structure of tropical rain forests, leading to other chapters that attempt to explain why biodiversity in rain forests is so much greater than those elsewhere. In two chapters he uses studies on Neotropical trees to cover key hypotheses that may explain the maintenance of the diversity in tropical rain forests. Kricher does a fine job at this, being careful to provide several hypotheses with effective examples. He is also careful to provide older and newer explanations and successful in making it clear that the ultimate answer is not restricted to a single hypothesis. Finally, Chapters 7 and 8 address biotic interactions and trophic dynamics, showcasing the complex interactions that result from the rich diversity in rain forests, and how these, perhaps, feed into the creation and maintenance of diversity itself. With the tropics cradling most of the diversity on the planet, it makes sense that nearly half of the textbook is dedicated to addressing

Chapters 9 and 10 cover productivity and nutrient cycling in the tropics, going over tropical rain forests' uniquely high rates of primary productivity and the crucial role of nutrient cycling in rain forests because they often grow on poor soil. Especially helpful is a section on carbon sequestration, a currently hot topic because rain forests could potentially act as carbon sinks to offset climate change. These topics are outside my field of expertise, and I found the chapters very easy to follow and helpful. Students should likewise find them easy to grasp.

Pointing out that most people associate the tropics with tropical rain forests, Kricher spends the next two chapters covering the other terrestrial ecosystems in the tropics. Chapter 11 covers tropical savannas, revisiting previous concepts that were covered with rain forests. Here, Kricher focuses on African savannahs as an example, which is a welcome change to the Neotropical bias found throughout the textbook. Chapter 12 covers the remaining ecosystems in the tropics, such as montane/cloud forests and mangrove and riverine ecosystems. Again, he uses the concepts covered in the rain forest chapters to discuss these other ecosystems. He provides a very clear and useful overview of these other tropical ecosystems.

The final three chapters discuss how humans have modified the tropics, starting with indigenous peoples and continuing to more modern and global changes. Chapter 13 focuses on the ecological effects of early human communities in the tropics, such as hunter-gatherers and early agricultural societies. Chapter 14 then proceeds to describe how fragmentation directly affects biodiversity, using a few key examples from Neotropical studies. Chapter 15, the final chapter of the text, provides a broader view of the anthropogenic causes of loss in biodiversity and ecosystem services in the tropics, as well as global climate change. Kricher does a fine job summarizing the crisis we face today, and how loss of diversity in the tropics will have global and lasting effects. Concluding with these chapters makes perfect sense, as students can more greatly appreciate the need to conserve the tropics after reading the preceding chapters of the textbook.

As this textbook follows at the heels of Kricher's successful *Neotropical companion*, it is no surprise that the text is clearly written and should be accessible to undergraduate and starting graduate students, the primary target of this text. The textbook is written in a narrative that, despite its length, is easy to digest. Kricher uses approachable examples with clear illustrations, and the text is well organized. As a whole, the textbook is nicely done and should provide a wonderful complement for a course in tropical ecology.

The textbook, however, can be improved in at least three ways. First, having better summaries and perhaps problem sets or points of discussion at the end of each chapter would enhance the textbook's utility for a course. Although there are recommendations for further reading and concluding remarks for some chapters, explicit exercises and summaries would be helpful. Second, the text is heavily biased with examples from the Neotropics, a bias that Kricher himself apologizes for in his Introduction. The bias may be inevitable, as much tropical fieldwork is done in the Neotropics (Kricher's own background is in Neotropical ornithology). There is, however, a long and rich history of work in Old World Tropics, like the pioneering work of Mayr and Wilson in the South Pacific, and, of course, Wallace in Asia and Melanesia. More recent work is also emerging, especially in Australasia, Melanesia, and Southeast Asia. This is an important short-coming. After all, this is a textbook in tropical, and not Neotropical, ecology. Future editions of this textbook should treat the other half of the globe a little more equitably. Finally, a longer section on the future of tropical ecology, possibly near the end of the book, would help inspire future biologists. Kricher does include a section in the first chapter about the future of tropical ecology, but this is lost and cannot be appreciated without knowledge of the current state of tropical ecology. It is wonderful to end with issues in conservation, but also good to end with a scientific call.

At the conclusion of the text, I asked whether a textbook in tropical ecology is indeed needed. Kricher was successful in the daunting task of assembling the massive information and data on work in tropical ecology under a single and very accessible book. As tropical ecology courses typically focus on the natural history of the tropics and this text is built around this concept, this textbook should be of great utility for tropical ecology courses. However, its utility depends on the focus of the course. This textbook, for instance, would work well as companion

reading for a field course in the Neotropics, but not so much if one were to lead a course in Africa, Australia, or other parts of the world. In general, however, Kricher was successful in convincing the reader about the unique contributions of tropical ecology to our understanding of ecological processes, especially to our understanding of how biodiversity is generated and maintained. This textbook is a wonderful starting point or reference for students and those generally interested in learning more about tropical ecology.

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## Biodiversity for nonscientists

Silvertown, Jonathan, editor. 2010. **Fragile web: What next for nature?** The University of Chicago Press, Chicago, Illinois. 192 p. \$25.00, ISBN: 978-0-226-75781-0 (alk. paper).

Key words: biodiversity; ecosystem services; ecosystems; extinction; human impact.

"Biodiversity" is a term that most people have heard but relatively few understand. People are told that it is important, but it seems doubtful that most could provide a strong argument to that effect. The present volume is intended to help remedy this situation, by providing an introduction for nonscientists to biodiversity and its importance. More specifically, the book is intended to educate about what biodiversity is, about threats to biodiversity, and about consequences of the loss of biodiversity. It succeeds in all three areas.

After a brief chapter on the human environmental footprint, the first section discusses the origins of biodiversity. Chapters on the history of life, biogeography, species and speciation, and genes and genetic variation provide a rich basis for the rest of the book. In roughly eight pages of print, the chapter on the history of life manages to cover considerable ground, including the origins of photosynthesis and the Earth's oxygen atmosphere, the origins of sexual reproduction, the appearance of complex food webs, and historical patterns of extinction and adaptive radiation. The biogeography chapter struck me as especially interesting because it went well beyond describing patterns of diversity; it posed particular questions about why some regions (like the fynbos of South Africa and the Amazon basin) are so species rich while others (like the Sahara) are so species poor. The chapter on species did an impressive job of simultaneously avoiding the morass of discussing alternative species concepts while managing to give a number of clear illustrations of studies of speciation and species isolating mechanisms. I thought the chapter on genetics was somewhat weaker than the others. In telling readers simply that genes make proteins, which are "much of an organism's biochemical machinery and structure" it seemed to me that it missed an opportunity to educate about heritability and the basis of phenotypic variation. Similarly, the discussion of the importance of the loss of genetic variation struck me as oversimplified, as inbreeding depression is not an inevitable consequence of inbreeding. Indeed, it is understandable if readers miss the fact that most genetic studies in conservation today are aimed at inferences about population size and migration, not at long-range concerns about adaptability of populations or inbreeding depression.

The second section concerns ecosystems—implicitly treated as emergent properties of all the diversity covered in the first section—and their function, with a focus on implications for humans. Chapter 6 does an admirable job by discussing the importance of soil and marine food webs for the global carbon cycle. The focus on these systems may be particularly important in impressing upon readers the importance of systems (and organisms) that are neither charismatic nor well known to most. The subsequent chapter discusses some important ecosystem services—such as food production, water supply, and waste treatment—and the impact of species diversity on those services. The latter issue is, of course, not yet well understood, but the chapter does a good job of conveying a number of the nuances involved, such as the degree of redundancy in ecosystem function. Chapter 8 does a remarkable job of introducing more nuance, in discussing the history of attitudes towards landscapes. I found myself wishing for more discussion of the issues raised at the end of the chapter, including controversies over the goals of restoration and management, and the relationship between these and social justice. But perhaps the issues can only be mentioned in a broad work of this sort. Chapter 9 is an interesting exploration of "nature" in urban settings, which most readers will find informative. The final chapter in this section is a discussion of the importance of freshwater ecosystems and threats to them. One point that I thought might be made is that many of the issues also affect estuarine systems.

The final section is on the future of biodiversity and of major ecosystems. It opens with a chapter on evidence that we are already in a sixth mass extinction, focusing on oceanic islands and on declines of amphibian populations. It concludes with a

discussion of measures aimed at slowing or reversing the tide of extinction, making it clear that we are a long way from success. One reason the subsequent chapter (on the collapse of marine fisheries) is so interesting is that it documents both the severe decline in many fisheries and the rapid responses of a number of fisheries to protection. On the other hand, the next chapter, on climate change, is not so sanguine, perhaps because of the great complexity of issues like changes to the structure of food webs. I was a bit surprised to see substantial attention to the idea of assisted migration; regardless of what one thinks about it (disclosure: I am highly skeptical), it seems clear that it is not likely to be a general solution even to extinction caused by climate change, much less to changes in ecosystem function. Chapter 14 introduces readers to the problem of invasive species with some familiar examples (including kudzu, European starlings, cane toads, Melaleuca, Caulerpa, and zebra mussels). Readers will be convinced that there are some severe problems resulting from invasions, but the chapter does not provide an introduction to the more subtle or complex problems (like species that do not become pests, invasions that are not human-assisted, or invasions by pathogens). Likewise, some discussion of issues related to control of pests would greatly strengthen this chapter. The book concludes with a chapter that asks "What next for nature?" and focuses on the notion of sustainability.

Nine authors contributed to this volume, but the editing by Silvertown makes it nearly seamless. The prose is clear and free of jargon. The gorgeous illustrations (taking perhaps 40–50% of the space) help to make the book appealing. But these are informative illustrations, not ecoporn. There is a strong effort to make the book international (e.g., by giving costs in both pounds sterling and U.S. dollars).

The introduction says that the book is intended for "everyone" because they will decide the question "what next for nature?" However, it is probably most appropriate for educated nonscientists, including university students in non-majors courses and others who simply want a broad and readable introduction to biodiversity and the future of the natural world. One can quibble (and I have) about a few points, but overall this volume is a valuable and appealing addition to environmental literature.

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## Repeat photography—pictures worth a thousand words

Webb, Robert H., Diane E. Boyer, and Raymond M. Turner, editors. 2010. **Repeat photography: methods and applications in the natural sciences.** Island Press, Washington, D.C. xx + 337 p. \$125.00 (cloth), ISBN: 978-1-59726-712-0 (alk. paper); \$75.00 (paper), ISBN: 978-1-59726-713-7 (alk. paper).

Key words: dryland ecology; glaciers; landscape change; repeat photography; southwest U.S.

This book is excellent, with much to offer both the specialist and the more general reader. It comprehensively explores the techniques and applications of repeat photography and will prove the benchmark in the field. It has been assembled and carefully edited by three senior USGS scientists (an hydrologist, an archivist, and a biologist) who have worked with repeat photography projects throughout their careers. The book provides a broad sweep of the field updates information about techniques and celebrates and acknowledges prior accomplishments. It is dedicated to Hal Malde and has an extended forward by George Gruell, both significant pioneers in this field. The text contains 23 papers, written specifically for this volume, that review applications of repeat photography across diverse disciplines. The 36 chapter authors have long familiarity with the technique and some papers provide capstone reviews of work accomplished over several decades. The book is well illustrated throughout, with a central section of 30 color pages. However, separation of the color plates from the associated text is a minor irritant and some of the black-and-white illustrations within the text are a little murky. The editors have done an excellent job of cross-referencing among individual papers and standardizing the usage of some common terms (e.g., all plant species are generally referred to by their Latin names).

Following the editors' preface, the book is divided into five thematic sections, each preceded by a 1-2 page overview. Part I, "Techniques," contains five papers and begins with a brief historical overview by the editors. They also contribute the second paper reviewing the techniques used in the Desert Laboratory Repeat Photography Collection currently housed by the USGS in Tucson. All three editors have long involvement with this venerable project which has a massive collection of over 35000 archival photos dating back to the 1860s, including several systematic repeat photography projects of landscapes throughout the U.S. southwest. Taken together these two papers define and outline most standard approaches that have utilized repeat photography-location and matching of "vintage" photos (often taken for quite different usage), plus repeated opportunistic or systematic fixed-point photography that documents landscape or vegetation changes. These two papers also address many technical issues (e.g., camera equipment, documentation and reoccupying site locations, archiving images, and matching light and seasonal conditions). Chapter 3, by Thomas Hanks et al. discusses the problems involved in rephotography projects where the original camera location is unknown, e.g., on poorly documented exploratory traverses. They describe examples of novel techniques using GIS, Google Earth, and DEMs to construct synthetic landscapes, enabling the viewer to "walk into the view" and thereby narrow down possible camera station locations prior to a field-based search. Mark Klett discusses ways of comparing images using examples from the Rephotographic Survey Project for expeditions of the 1860s-1870s in the American west where later camera stations may differ slightly from the

original. He also evaluates presentation techniques, the common side-by-side style but also overlay, geometric matching, dissolving digital versions, and reconstructing panoramas from adjacent photo viewpoints of a similar view taken at different times. The problems of matching images in rapidly changing built environments are also discussed. In the final paper of this section, Hoffman and Todd demonstrate change detection techniques for semi-arid vegetation in South Africa, matching the increase and decrease in vegetation cover and individual species over time using traditional field surveys, repeat photography, and modern digital techniques. These include using GIS to develop "differenced" images to highlight changes between time periods.

The remaining four sections are basically thematic and deal directly with specific problems and the use of repeat photography to address those problems. The presentations are interesting and diverse, often reflecting synthesis over a career working in the field. Each paper lays out the problem, with extensive background material before demonstrating the precise ways that repeat photography has been used to address the research questions. Understandably many articles focus on landscape changes and the dynamic climatic, anthropogenic, agricultural, social, and economic factors that have initiated those changes. They also attempt to untangle the relative roles these factors play in the landscape changes that are graphically illustrated by the images. These papers convincingly demonstrate how a carefully thought-out and extensive search of archival sources can provide critical photographic data on landscape change. They also provide creative examples of where to search for these materials.

Repeat photography of glaciers was the first, most effective, and extensively used technique to document glacier fluctuations. In the first paper in Part II (geoscience applications) Bruce Molnia reviews and catalogs the rich historical archives of terrestrial and aerial photography of glaciers in Alaska, including the classic work of Bradford Washburn and Austin Post. Glacial geomorphologists will recognize many iconic images from the 10 pages of color plates as Molnia presents an exhaustive catalog of these early collections and the historical expeditions that provided them. Fagre and McKeon discuss the USGS Repeat Photography Project in Glacier National Park, Montana which has been of one of the most effective recent applications of repeat photography. Imagery from some of the 60 glacier stations they carefully collected has been widely used in global change presentations. This is one of many examples where the authors sought individual early tourist and promotional literature in order to access suitable candidates for repeat photography that show glacier and landscape changes, e.g., at treeline. The paper also documents the importance of website development and outreach that makes suitable matched digital images available for use as promotional tools in environmental messaging. Repeat photography is also used by Webb and Hereford to illustrate the evolution and possible causes of arroyo formation in Utah and Arizona. Sequential aerial photography provides quantitative measures of channel changes and revegetation of channels after floods. Finally Paul Bierman uses historic photos to illustrate anthropogenically induced landscape change due to clear-cutting and subsequent reforestation in the temperate landscapes of Vermont in the late 19th century.

Part III, population ecology, contains two papers both dealing with recruitment and mortality of erect species in dry environments—Carnegiea gigantea (saguaro) and Prosopis (mesquite) in the Sonoran desert and two Aloe species in South Africa. Historical photos are used to show mortality, recruitment, and population changes of these easily visible species, while pointing out the difficulties of discriminating between dead and dormant leafless flora in dry environments and accurately identifying juveniles. They also demonstrate how

carefully measured, dated images can be used to estimate growth rates and provide inferences about the age of species without annual rings. Hoffman's work in southwest Africa shows the utility of these techniques for monitoring changes in endangered species over time.

Part IV, ecosystem change, is the longest section and covers diverse, mainly dry, environments from Kenya, Ethiopia, Australia, the deserts of the U.S. southwest and temperate forests in Argentina and Chile. These papers explore and attempt to disentangle the effects of climate change, fire, grazing, and anthropogenic influences on population dynamics of vegetation in these landscapes, using the full range of ecological and repeat photographic techniques.

Tom Veblen uses historical photos as the source of research questions, inspiration, and hypothesis testing in his investigations of the disturbance ecology of *Nothofagus* forests in Chile and Argentina. Starting in 1975, his observations of vegetation disturbance by landslides generated by the 1960 earthquake led to development of the hypothesis that regeneration of shade-intolerant *Nothofagus* depends on disturbance and these disturbances are too frequent to allow development of a full post-*Nothofagus* "climax" community. Air photos are also used to investigate differences in flammability of these forests that lead to sharp post-fire boundaries in the vegetation. Dense stands of the upper-elevation *Nothofagus pumilio* can act as fire breaks in all except the driest years.

Jan Nyssen et al. use paired 1975 and 2006 dry season photos to challenge the assumption that production of more crops, generated by population pressure, has resulted in land degradation and high rates of deforestation in Tigray (Ethiopia). Based on expert assessments of measures of land degradation observed on paired images they conclude that, in Tigray at least, increased population over the 31-year period has not led to degradation. More significantly, they showed that environmental degradation in these semi-arid environments can be reversed by appropriate farmer-centered policies.

Tourist photographs, particularly low-level obliques from specific spots, are used by David Western to investigate the effects of people, elephants, and grazing on habitat changes in Amboseli Game Reserve, Kenya over a 40-year period. Partition of this diverse landscape between natural game reserves and pastoralist lands severed the previous seasonal migration pathways that maintained the patchwork dynamics of the vegetation of the region prior to establishment of the park. The increased activity of elephants is shown to deplete the Acacia woodlands, replacing them with scrub vegetation and grasslands whereas grazing by large herds of domestic livestock tends to promote more woody vegetation. Better documentation of these long-term trends, based on repeat photography, is shown to provide a significant tool for understanding the changing ecological dynamics of these landscapes and also park management. Darrell Lewis uses repeat photography to document landscape changes in the Victoria River District of the Northern Territories of Australia from the time of original European settlement in the 1890s to the present. He demonstrates significant effects from extensive cattle overgrazing and an increase in riverine woodlands in the last 40 years due to unknown causes

Two studies examine changes in American dryland land-scapes. McClaran et al. examine the conversion of open grasslands to shrublands at the Santa Rita Experimental Range in Arizona over the 20th century. They use plot data and intermediate-scale (5–10 years) repeat photography from elevated locations, aerial photo and satellite data, plus permanent transects to examine the temporal and spatial dynamics of vegetation in desert grassland and scrub areas. They also discuss the potential of aerial photography and satellite imagery to explore the changing dynamics of the shrub communities, mainly *Prosopis* (mesquite) that can be seen on

the small-scale imagery. Turner et al. use plot data, old photographs, repeat photography, and newspaper accounts to show the effect of fires on low elevation sites in the Sonoran, Mojave, and Great Basin Deserts. These studies suggest that more frequent fires, due in part to invasion of non-native grasses and anthropogenic triggers, are leading to ecosystem conversions as original desert species are not well adapted to fire. As the original desert vegetation had too little fuel to sustain burning, they conclude that "establishment of nonnative vegetation, and the increased fire hazard that this vegetation creates, strongly suggest that, once burned, these desert ecosystems likely will not recover, but instead will shift to a different vegetation type controlled by more frequent fires."

Cultural applications are the focus of the six essays in Part V. Richard Rohde uses historic photos taken between 1926 and 1943 to demonstrate significant ecological and economic changes in crofting landscapes in the northwest Highlands of Scotland. Biodiversity is lost as abandoned agricultural lands are colonized by sedges and bracken or replaced by industrialized fodder production. There are also significant changes in the economic and cultural landscape as crofting communities are transformed by holiday homes. In similar fashion, Peter Moore uses 19th century tourist shots, postcards, and tourist brochures from the Cairngorm Mountains in Scotland to show changes in the human landscapes and land use, including the recovery of roads and increased woodland in the National Park. Joby Bass takes a more socio-cultural perspective in comparing repeat photography of urban and village landscapes in Honduras after 50 years and uses the reactions of the local people to these changes to give additional contextual information about change. Tom Jonas matches contemporary images with expedition photographs and earlier (mid-19th century) artwork to relocate former campsites and expedition trails across the American southwest. This includes interesting commentary on the accuracy of sketched and painted landscapes, including discovering the correct location of an 1853 watercolor of a canyon, some 180 km from where it was earlier assumed to be. Finally William Howard and colleagues use rephotography of images of archeological sites in Mesa Verde, Colorado, taken by Gustaf Nordenskiöld in 1891, to monitor slow and catastrophic (rockfall) natural changes at these sites. These images can be used to assist future restoration projects but also show the effectiveness of past stabilization efforts.

In the concluding chapter, "The future of repeat photography," the editors stress the unique role repeat photography can play in monitoring landscape change and hypothesis testing because of the long temporal perspective and detail that these studies provide. Archived images preserve snapshots in time that are benchmarks against which to document change. New techniques of digital manipulation and different types of imagery offer new opportunities to exploit these archives, e.g., the work with DEMS, GIS, and satellite imagery, and the editors foresee potential for continued and increased use in global change studies. However, in this world of rapidly changing technologies they express concern about the need to develop protocols for the storage and archiving of future digital data.

This book will become standard reference for all who use repeat photography and an important source for individuals interested in landscape and vegetation change over extended time periods. Given the location and experience of the editors, about half of the papers utilize examples from the southwest U.S. and many of these papers will be of particular interest to dryland ecologists. However, there is a wealth of diverse and fascinating studies for others to enjoy—the ones on glaciers, archeology, and Scottish crofting were of particular interest to this reviewer. The editors are to be congratulated on assembling and crafting such a powerful demonstration of the scope, relevance, and interest of this fascinating field.

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