# Book Reviews

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## Effects of Land-Use Change on Ecosystems

DeFries, Ruth, Gregory Asner, and Richard Houghton, editors. 2004. **Ecosystems and land use change.** Geophysical Monograph Series, Volume 153. American Geophysical Union, Washington, D.C. viii + 344 p. $80.00, ISBN 0-87590-418-1.

*Key words: ecosystem responses; land-use change.*

Humans live and act on landscapes, and thus have modified and transformed them since antiquity. However, the past century has evidenced unprecedented, greatly accelerated landscape changes, resulting in pervasive and profound ecological and socioeconomic consequences throughout the world. Through altering the structure and function of landscapes, humans, in most cases, intend to increase their appropriation of ecosystem goods. However, these activities undermine the abilities of ecosystems to perform other functions and services, and are always accompanied by a series of unintended (and often undesirable) consequences. As long as the human population continues to grow, their alterations of landscapes are more than likely to keep accelerating. Does this mean that the sustainability of future human-environment systems is an unattainable fantasy unless Malthusian catastrophic factors such as famine, epidemics, and wars keep the human population under control? If this is not true, then how should humans interact with their landscapes to achieve an ecologically, economically, and socially sustainable world? More specifically, scientists, policy makers, and stakeholders must address the following pressing yet poorly understood questions: What are the short-term versus long-term consequences of land-use change for biodiversity, ecosystem functioning, and the goods and services ecosystems provide? How do different types of ecosystems respond to land-use change across spatial scales and geographic locations? How can we minimize negative ecological consequences while acquiring ecosystem goods and services from our landscapes? Well, these are some of the questions that have motivated DeFries et al. to organize this book on impacts of land-use change on ecosystems.

This book has evolved out of the American Geophysical Union Chapman Conference on ''Ecosystems interactions with land-use change,'' held in Santa Fe, New Mexico during June 14–18, 2003. The purpose of the conference and thus this book was ''to synthesize current understanding of land-use change causes and consequences from diverse disciplines, ranging from hydrology to public health to ecology to social science.'' The book is divided into three sections with 24 chapters in total, including the introduction and conclusion chapters prepared by the editors. The number of chapters in each section is quite uneven: Section 1 (''The multiple ecosystem responses to land-use change'') has 13 chapters; Section 2 (''Observing, forecasting, and hindcasting land-use change'') has only three chapters; and Section 3 (''Regional case studies of ecosystem interactions with land-use change'') has six chapters. The emerging science of land-use and cover change (LUCC), or ''land-change science'' (LCS) is increasingly recognized as a critical component of global environmental change and sustainability science (Rindfuss, Ronald R., Stephen J. Walsh, Billie L. Turner II, Jefferson Fox, and Vinod Mishra. 2004. Developing a science of land change. Proceedings of the National Academy of Science **101**:13 976–13 981). LCS consists mainly of three components: observing and monitoring LUCC, understanding effects of LUCC on ecological processes and ecosystem goods and services, and untangling biophysical and socioeconomic mechanisms of LUCC. DeFries et al. clearly recognize the three components, and several contributors to the volume, including the editors, are leaders or active participants in the recent movement of promoting LCS. However, this book focuses mainly on various ecosystem consequences of LUCC. The distribution of the number of chapters among the three sections apparently reflects this emphasis. Given the extensive scope and intricate complexity of LUCC, this is reasonable. Plus, there is an urgent need for improving our understanding of the impacts of LUCC on biodiversity and ecosystem functioning, which is a central issue and top research priority in landscape ecology (Wu, Jianguo, and Richard Hobbs. 2002. Key issues and research priorities in landscape ecology: an idiosyncratic synthesis. Landscape Ecology **17**:355–365).

This book adopts a broad definition of land-use change that includes both land conversion and land management changes, both affecting ecosystem goods and services. Several types of land-use change are considered: deforestation, agriculture, urbanization, grazing, damming and irrigation, and wetland drainage. As the main thrust of the book, most chapters are reviews or case studies of how these different kinds of land-use change influence hydrological regimes, climatic conditions, biogeochemistry, human health, and biodiversity on a watershed or regional scale. Some of the most informative chapters are those dealing with climatic and hydrological responses, while the effects of land-use change on biodiversity, ecosystem functioning, and human health are, in general, most poorly understood. The geographic coverage of the book is broad, including Asia (China, Mongolia, Russia, and Vietnam), Africa, North America, and South America (Amazon), but it is a little odd to see the apparent lack of case studies from European countries, which have a long history of land-use change and where many exciting LUCC studies have been done. Nevertheless, it is evident from the book that ecosystem responses are a function of land-use type, biophysical and ecological conditions, and socioeconomic and geopolitical settings. In certain cases, convergent ecosystem responses may occur as deforestation, agriculture, and urbanization all tend to increase nutrient losses from terrestrial to aquatic systems. However, divergent responses dominate in most other cases. For example, deforestation warms climate in the tropics, but cools it in the temperate and boreal

regions because of geographic differences in its relative effects on evapotranspiration and surface albedo. Also, effects of grazing on biodiversity and ecosystem functioning vary among arid, semiarid, and humid ecosystems.

The editors should be commended for providing a comprehensive framework and insightful synthesis for this extremely complex topic through the introductory and concluding chapters. In particular, the typological responses of ecosystems to land-use change and trade-offs between intentional versus unintentional consequences, as summarized by the editors, not only integrate all the chapters nicely, but also help elevate our understanding to a new level. There are a few shortcomings, though. While most chapters are high quality, some seem merely agglomerations of previously published results. The book does not have an index, which could be quite useful. Particularly disappointing, however, is the lack of in-depth studies of how landscape pattern affects ecosystem processes. Land-use change is a spatial process, and obviously landscape pattern matters for understanding ecological consequences. The relationship between landscape pattern and ecological processes is the central theme of landscape ecology (Turner, Monica G., Robert H. Gardner, and Robert V. O'Neill. 2001. Landscape ecology in theory and practice: pattern and process. Springer-Verlag, New York). Surprisingly, the tremendous amount of relevant literature in landscape ecology is essentially absent in this book.

The editors sound modest when they write: ''We view this volume more as a starting point for future research and syntheses rather than as a final, comprehensive summary of ecosystem responses to'' land-use change. Certainly, among dozens of books on LUCC, this one stands out for its conspicuous emphasis on ecosystems. The pervasiveness and complexity of effects of land-use change on ecosystems conveyed here are overwhelming, and may be disappointing or even frightening to those ecologists who are stuck in their armchairs obsessively seeking the elegance of mathematical theory. Those who love to indulge themselves in the few remaining patches of wilderness dedicatedly discovering nature's mysteries may find this book thought-provoking, or somewhat disturbing. To most scientists who study ''things'' or ''stuff'' on real landscapes, however, this book deserves a place on their bookshelves. As a landscape ecologist, I enjoyed the reading, but couldn't help asking myself: what have we landscape ecologists been doing?

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## THE RIVER THAT FLOWS WITH ALPHABET SOUP

Fremling, Calvin R. 2005. **Immortal river: the upper Mississippi in ancient and modern times.** The University of Wisconsin Press, Madison, Wisconsin. xii + 429 p. $70.00 (cloth), ISBN: 0-299-20290-9 (alk. paper); $29.95 (paper), ISBN: 0-299-20294-1 (alk. paper).

*Key words: Mississippi river ontogeny; Mississippi river utilization; river management.*

Only a week prior to my submitting this review, I stood at the outflow of Lake Itasca, Minnesota, marveling at the large number of visitors who had come to see the relatively unspoiled source of the Mississippi River. Many of them were impressed with the luxurious stands of wild rice (*Zizania palustris*), doubtless unaware that some fifty years ago, such stands were uncommon. Most too were probably unaware that before the river leaves Clearwater County, many of its feeder tributaries have long since been modified at their sources by spillways (Elk Lake, Heart Lake, and Long Lake). From its headwaters region to the Gulf of Mexico, the Mississippi River is about as natural as we allow it to be. On Thursday, 14 July 2005, the U.S. House of Representatives approved by a 406–14 vote, $3.6 billion for lock and dam upgrades on the upper Mississippi and Illinois rivers—this in spite of two National Academy of Sciences reports indicating a lack of economic justification. Given this skewed vote, sadly few if any members of Congress have probably read Calvin Fremling's, *Immortal river*.

*Immortal river* provides an entertaining and integrated historical overview of the Upper Mississippi River basin, a region geopolitically defined as that stretch of the Mississippi River from St. Anthony's Falls, Minnesota, downstream to the mouth of the Ohio River at Cairo, Illinois. This region is perhaps the most fragile and politically contentious of the world's third longest river and drainage basin. The author furnishes background on the upstream headwaters and downstream Lower Mississippi to put his Upper Mississippi focus in perspective. Fremling, a true ''river rat'' in only the good sense, weaves geology, geography, anthropology, ecology, politics, and personal experiences into a fabric of natural and human history that culminates in the river as we currently view it.

This 24 chapter book is arranged into five parts: (1) ''The river primeval''—historical geology of the Upper Mississippi and early anthropology; (2) ''Exploration and early exploitation''—Europeans arrive on the scene; (3) ''Caging the giant''—expansion of navigation; (4) ''Ecological relationships''; (5) ''The river today and tomorrow''—current management and threats. It would be difficult to categorize this

work as a text, yet it is more than just non-fiction. It contains a wealth of information and, although written in a non-technical manner, requires some implied knowledge of river systems. *Immortal river* should be required reading for anyone concerned with balancing environmental and ecological needs with those of transportation and commerce.

Particularly valuable are the author's chapters (3–7) on the historical geology of the region. More than a primer, they elaborate especially on Pleistocene events so crucial to understanding the region, e.g., Glacial River Warren and Glacial Lake Agassiz, Glacial St. Croix River and Glacial Lake Duluth, the Unglaciated Area (aka, Driftless Area), etc. Terms such as katabatic and loess are well defined and applied.

Another particularly informative chapter is Chapter 19—''Mayflies! What the hell good are they?'' The author's longtime interest and experience with *Hexagenia* are very nicely conveyed.

Throughout, illustrations are well placed, functional, and not overly used. They complement the text well. Citations are appropriate, and the author has attempted to include references readily available in regional libraries. Typographical errors are essentially non-existent.

Various informative addenda are included throughout the text; in most cases these are welcome additions, but in some cases because of placement or sheer number (e.g., six in Chapter 14), somewhat detract from the readability of the text. However, some addenda are also particularly reflective of the comfortable writing style of the author and insert a degree of welcome humor not otherwise found in such works, e.g., ''Hello, Hawkeye Hotel'' and ''Talking to a Mayfly.''

*Immortal river* begins with an extensive list of abbreviations found throughout the text, and ends with two chapters the author considers ''controversial.'' Most of the abbreviations involve governmental agencies, commissions, and the like, all with some level of involvement in management of the Upper Mississippi River; the final two chapters address environmental and ecological concerns, often the result of activities by one or more of the above ''abbreviations.'' Perhaps the most compelling illustration found in this work is the flowchart of Upper Mississippi River management structure and major program areas. I applaud the author for sharing it with a larger audience through *Immortal river*.

Professor Fremling successfully combines both an extensive geochronology and historical survey of human utilization of one of the world's most significant resources, and does so with relatively little jargon, a touch of humor, and style that can perhaps best be described as ''informative prose.'' Far from being cumbersome, this book contains a wealth of information, logically and comfortably presented. The Mississippi River, particularly its upper basin, exemplifies the dilemma of an ever increasing human presence—an extensive landscape resource that needs to be managed both for human transportation needs and broad scale ecological health. *Immortal river* thoroughly addresses this dilemma and its inherent frustrations. Although well suited for a broad audience, especially those living within the Mississippi River basin, this book should be particularly valuable for broad-scale ecologists, environmental economists and historians, and anyone associated with environmental policy/decision making.

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## Points of Interest: Understanding Spatial Patterns

Fortin, Marie-Josée, and Mark Dale. 2005. **Spatial analysis: a guide for ecologists.** Cambridge University Press, New York. xiii + 365 p. $110.00 (cloth), ISBN: 0-521-80434-5; $55.00 (paper), ISBN: 0-521-00973-1.

*Key words: autocorrelation; spatial analysis; spatial ecology; spatial point processes; time series analysis.*

Ecologists increasingly use spatial analysis to describe and analyze populations, communities, and the features of landscapes. Yet while there is much interest in the topic and a growing body of literature, most ecologists have little knowledge of the statistical tools available. A great diversity of techniques exist for analyzing spatially explicit data, so many in fact that those looking for the ''right'' approach can quickly become discouraged by the sea of choices. What's more, spatial data often introduce problems for standard parametric tests (e.g., ANOVA). For example, spatial data generally do not meet the assumption of independence on which the power of many tests strongly depends. The value of a variable such as soil moisture at two points in space tends to be more similar the closer the points are to one another, a phenomena known as Tobler's law. Hence, standard statistical tests often do not apply and researchers must resort to Monte Carlo techniques to generate appropriate probability distributions. The spatial pattern of a given variable can also change dramatically with geographic scale. For example the distribution of tree seedlings may be overdispersed (relative to a random pattern) on the scale of a few meters, but clumped on scales of hundreds of meters. Another problem is non-stationarity, in which the explanatory process of observed patterns changes from one

place to another. The above examples underscore the need for statistical approaches that are suitable for spatial data. For ecologists unfamiliar with spatial analysis, a guide to its proper application would be of great practical benefit, and it is precisely this role that Fortin and Dale fill with their book.

The authors' goal, they say, is to provide a conceptual foundation in spatial analysis for ecologists. The statistical analysis of spatial patterns involves the characterization, quantification, comparison, and simulation of spatially explicit data. Fortin and Dale attempt to review, compare, and summarize the techniques associated with each of these topics. The overarching goal is to establish the logic and philosophy that motivates the design, and thus the application, of spatial techniques. This is a big task for a mid-sized book, which at 365 pages is about the length of Nicholas J. Gotelli and Gary R. Grave's popular *Null models in ecology* (1996. Smithsonian Institution Press, Washington, D.C.). Here, as in that book, the chosen topic is vast and difficult to summarize. And the similarities don't end there. Each book reviews statistical techniques while interjecting advice and counsel on their application.

As in *Null models, Spatial analysis* is a book of concepts. Concepts are wedded tightly to theory, and theory to philosophy. For good or ill, it soon becomes clear that Fortin and Dale's book is also a vehicle for commentary on the philosophy of ecological science, particularly as it pertains to the formulation and testing of hypotheses. For example the authors advocate against using a single null hypothesis, and suggest researchers consider a hierarchy of increasingly more constrained or more complex models. What we get is not so much personal opinion as the wisdom of experienced guides. In the end, Fortin and Dale deliver a comprehensive introduction to the topic of spatial analysis that is at once informative, insightful, and practical.

The book is organized into seven chapters. After introducing several key concepts and definitions, the authors go on to discuss the philosophy and analytical techniques of mapped point data, quadrat sample data, continuous data (e.g., soil moisture), the detection and delineation of boundaries and patches, spatial autocorrelation, and spatio-temporal data. Several critical issues are discussed throughout the book, such as the effects of non-stationarity, plot boundaries (edge effects), and autocorrelation. However, the depth of the treatment on the actual mechanics of each technique is uneven. Some commonly used statistics, such as Ripley's K and its extensions, are given several pages of discussion, while others, such as trend surface analysis, are tersely addressed in but a few paragraphs. Spatial autocorrelation, an important subject to be sure, is given an entire chapter. The authors repeatedly lean on several texts (e.g., Cressie, Noel A. C. 1991. *Statistics for spatial data*. Wiley, New York) to extend the reach of their explanations. At times they lean rather heavily. This approach is more demanding of the reader, and in reading the explanations for techniques I sometimes felt I had missed something. But again, the book is not intended as a methods manual per se.

Readers will find considerable overlap with Dale's earlier book, *Spatial pattern analysis in plant ecology* (Dale, Mark R. T. 1999. Cambridge University Press, New York). However, Dale's previous book covers fewer topics, focuses on static patterns, and generally includes more detail on implementation. The present book has expanded the discussion on some topics (e.g., network analysis), introduced new material (e.g., significance testing and spatio-temporal analysis) and diffused the discussion of other topics among multiple chapters (e.g., multivariate data). Fortin and Dale also take a more comparative approach here than Dale's previous work, offering much more in the way of comparison charts and tables. This additional material solidifies conceptual understanding and also provides an excellent survey of spatial techniques. For this reason the book will be useful to those seeking guidance on which approach best addresses a specific data type, experimental design, and purpose.

The chapter on spatial autocorrelation (Chapter 5) deserves special mention. The autocorrelation of data values is the most pervasive problem encountered with spatial data. Fortin and Dale's discussion is well organized, accessible, and informative. The authors use models to illustrate and explain the problems associated with autocorrelation. This makes the reading dense at times but it also makes the explanations more precise. Once again the authors offer their own insights on the problem, and suggest several techniques to aid the analysis of autocorrelated data.

Fortin and Dale impart much sound advice regarding the application and potential methodological pitfalls of spatial techniques, with frequent digressions on implications of a technique for the design of experiments. They write with authority and insight, and have infused the book with many nuggets of wisdom. As such the book is an excellent choice for a graduate seminar, although some supplemental reading of the cited references may be necessary. The book includes numerous tables, diagrams, and graphs throughout the book to clarify and solidify concepts. An especially useful feature are the end-of-chapter tables that summarize the distinguishing features of the methods presented on mapped point data (Chapter 2), quadrat samples (Chapter 3), and spatial partitioning (Chapter 4). I found these to be of great help in clarifying my understanding of the similarities and differences of the techniques, and how and when they can be applied. In addition, each chapter provides a summary of conclusions and a final appendix is included that classifies spatial statistics according to data type. These organizational tools improve the usefulness of the book as a reference, and it is bound to be one of those ''manuals'' I reach for on a regular basis for a quick check of an equation, a definition, or a key concept. Regarding the physical quality of the book, the clarity and resolution of the graphics is excellent, as is expected of Cambridge. The pages are bright white with a semi-glossy feel and the text is sharp. In the end, this book provides a comprehensive survey of the underlying concepts of spatial analysis. It is well worth reading by anyone who deals with spatial data.

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# The Global Scale and Study of Migration

Greenberg, Russell, and Peter P. Marra, editors. 2005. **Birds of two worlds: the ecology and evolution of migration.** The Johns Hopkins University Press, Baltimore, Maryland. xi + 466 p. $110.00, ISBN 0-8018-8107-2.

*Key words: adaptation; biogeography; bird migration; connectivity; population ecology.*

Few other natural phenomena invoke the same feelings of fascination and bewilderment as seasonal long-distance bird migrations and few other phenomena require the same level of integration of such a wide array of disciplines—physiology, endocrinology, neuroscience, paleoecology, behavioral ecology, evolutionary ecology—to arrive at satisfying explanations of observations. In 2002, a group of international scientists met at the National Conservation Training Center in Shepardstown, West Virginia, to discuss the current state of migratory bird research and *Birds of two worlds* is the culmination of these discussions. The publication of this work has both personal and professional interest. From a personal standpoint, it is another brick in the foundation laid by two previous symposium proceedings (Keast, Allen, and Eugene S. Morton, editors. 1980. Migrant birds in the Neotropics: ecology, behaviour, distribution, and conservation. Smithsonian Institution Press, Washington, D.C.; Hagen, John M., and David W. Johnston, editors. 1992. Ecology and conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington, D.C.) that provided equal parts inspiration and motivation to a naïve but enthusiastic graduate student. From a professional standpoint, *Birds of two worlds* represents a critical opportunity to reflect upon the path that the study of bird migration has followed, especially in the New World, and to chart the next steps.

One of the first things you notice upon cracking the cover of this volume is that, unlike the previous two works, *Birds of two worlds* adopts a global perspective in its subject matter and its list of contributors. The book is organized into 33 chapters divided among seven sections: ''Evolution of migration systems,'' ''Adaptations for two worlds,'' ''Biogeography,'' ''Connectivity,'' ''Migration itself,'' ''Behavioral ecology,'' and ''Population ecology.'' Within and across each of these thematic sections, several important threads emerge. First, the development and refinement of new research tools has allowed a rapid increase in our understanding of migration phenomena. Second, as migration research has become increasingly focused on individuals, it has become more and more obvious that migratory birds exhibit extraordinary flexibility and plasticity. Third, while it is well known that selection pressures during both the breeding and non-breeding seasons influence evolutionary trajectories of migratory birds, only recently has the importance of the interaction between seasonal selection pressures become apparent.

The development and refinement of research tools, both those from within the field of migration research and those borrowed from other fields, has improved our empirical facility in three critical areas: the ability to quantify population structure, the ability to link populations across seasons (migratory connectivity), and the ability to ''track'' individual birds throughout their annual cycles. Until recently, our knowledge of bird population structure and migration has relied on direct methods such as mark-recapture and radio and satellite telemetry. More recently, researchers have begun to focus on indirect methods that do not involve the limitations imposed by the need to recapture or re-sight marked individuals. Many of these methods are reviewed and put into practice in *Birds of two worlds*. Investigations of parasite faunas are starting to yield interesting insights into population structure and migration selection pressures. Genetic markers have been useful for identifying individuals originating from genetically distinct regions and stable isotopes are proving to be a rapid and relatively inexpensive tool for tracing individual movements.

Another research tool that has been used to great effect in the study of migration is less of a tool than it is a context—biogeography. Insights from the study of global migration patterns discussed in *Birds of two worlds* include independence of sympatric resident and migrant population ecologies, tropical origins of most long-distance migrants, the role migration plays in determining species distributions and how individuals utilize global climate patterns to facilitate long-distance travel. Also apparent is how poorly we understand austral migration (from south temperate to tropical regions) and the Eastern Palearctic-Oriental migration system.

Turning to the second thread, *Birds of two worlds* does an admirable job of conveying the importance of flexibility in migration, at multiple temporal scales and at multiple scales of organization. Plasticity is a critical component of a migratory lifestyle as migratory organisms encounter multiple selection regimes within a single year (the ''two worlds'' of the book's title). Physiological plasticity is required to accommodate multiple food types, as well as the extraordinary rigors of long-distance flight. Behavioral plasticity is required to accommodate multiple foraging and competitive environments. Migratory individuals also appear to be characterized by a suite of ''plastic'' cognitive characters, such as low neophobia, high generalization, and long-term memory. At an evolutionary scale, several chapters focus not on the evolution of migration but the role that migration plays as an evolutionary force in its own right. Migration can promote speciation by accentuating isolating mechanisms—one possible effect of strong migratory connectivity between breeding and non-breeding area—and can also impede speciation by generating high levels of gene flow between geographically separated areas. Finally, a paleoecological perspective highlights the fact that the last 5 million years have been very cool and, hence, have provided ample impetus for the evolution of a migratory lifestyle. However, this same long-term perspective reminds us that what we are currently trying to understand about migration represents only a snapshot of life on earth.

For the third trend, we turn to what is possibly the most compelling research development of the last decade—the recognition that understanding the life-history, ecology, and evolution of migration must involve explicit integration, both in theory and in practice, across all stages of the annual cycle. The effects and constraints generated by seasonal interactions and carry-over effects are critical components of migrant population dynamics and evolution. Perhaps the best-understood seasonal interaction is how arrival time and condition on the breeding grounds following spring migration influences eventual reproductive success and fitness. Arrival time and condition are dependent on a myriad of factors that exert their influence outside the breeding season, not the least of which is habitat quality during the non-breeding season and at stopover locations.

In a more colorful example, males of many migratory species maintain their bright breeding plumage throughout the non-breeding season, even though some of these species are not territorial during the non-breeding season. Viewed only in the context of non-breeding selection pressures, this observation appears to make little adaptive sense; for example, absent sexual selection pressures, colorful plumage is likely maladaptive in terms of predator avoidance. In the context of seasonal interactions, however, the observations become less incongruous. Males appear to retain their bright plumages because they cannot energetically afford the costs of re-growing them during the energy-intensive period leading up to the breeding season (the molt constraint hypothesis).

In conclusion, *Birds of two worlds* is an important volume that will be of value to anyone interested in migratory birds and migration. While gaps are inevitable in symposium proceedings (e.g., no chapter on navigation), the depth of coverage is impressive. In particular, the final chapter authored by the editors provides an excellent synthesis and call to arms. The volume's global perspective is timely and its forward-looking focus is sure to inspire the next generation of migration researchers while invigorating those already captivated.

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## Evolving Theory of Coevolution

Thompson, John N. 2005. **The geographic mosaic of coevolution.** The University of Chicago Press, Chicago, Illinois. xii + 443 p. $75.00 (cloth), ISBN: 0-226-79761-9 (alk. paper); $28.00 (paper), ISBN: 0-226-79762-7 (alk. paper).

*Key words: coevolution; dynamics of reciprocal selection; evolution of species interactions; geographic variation, interaction outcomes.*

Interactions between populations of different species play important roles in shaping both the dynamics of ecological systems and the evolution of constituent species. Study on the evolution of species interactions has focused on the co-adaptation between interacting species that has resulted from natural selection over long periods of evolutionary time. Such matching (and mismatching) of evolved traits between species has yielded valuable insights into coevolution. However, this approach to the coevolutionary process overlooks much of the ecological context under which coevolved traits emerge, including variation in interspecific interactions and ensuing selection pressures. Ever since Hutchinson's *The ecological theatre and the evolutionary play* (1965. Yale University Press, New Haven), there has been an ever-growing appreciation of the interplay between short-term ecological dynamics and long-term evolutionary processes. Indeed, the community context and ecological dynamics of interspecific interactions can have profound influences on the (co-) evolution of species interactions. Nevertheless, a general conceptual framework has largely been lacking for the ecological theatre of species interactions that choreographs the coevolutionary play. John Thompson's book, *The geographic mosaic of coevolution,* develops such a conceptual framework for understanding the ecological conditions and population processes that give rise to coevolution. This framework represents an important contribution to our understanding of species interactions, as it can be extended beyond the evolutionary and coevolutionary dynamics of interspecific interactions to include how geographic variation in species interactions can influence the structure and dynamics of communities, even in the absence of emerging coevolution.

*The geographic mosaic of coevolution* is a logical progression in Thompson's evolving ideas on coevolution and the evolution of species interactions. While this book expands upon his prior works, the ideas contained within this book are well organized and clearly presented, such that interested persons need not necessarily have read his prior books to fully grasp his current thinking on coevolution. As with Thompson's past books, a strength of this book is its extensive use of case studies to exemplify the conceptual framework developed throughout the text. Unique to this book, however, is a very useful appendix that presents a concise summary of the major concepts, mechanisms, and predictions contained within the book. Prior to reading the book, one may wish to first turn to this appendix for an overview.

The book is divided into two major parts. Part 1 (Chapters 1–8) develops the geographic mosaic theory of coevolution. The majority of this section expounds on Chapter 13 of his

prior book (Thompson, J.N. 1994. *The coevolutionary process*. University of Chicago Press, Chicago) in an endeavor to more thoroughly and logically develop the conceptual framework. Chapters 2–5 put forth the underlying ecological and evolutionary premises from which the conceptual framework is then developed in Chapter 6. These assumptions include that populations exhibit genetic differentiation; interacting species have geographically incongruent range distributions; species tend to be phylogenetically conservative in the species with which they interact; local populations of species tend to interact with only a few of the constituent species of communities; and the outcomes of interspecific interactions vary within and among communities. Based on these premises, Thompson predicts that the geographic mosaic of (reciprocal) selection pressures on species traits leads to coevolutionary hotspots and coldspots, which in combination with trait remixing (gene flow, genetic drift, mutation, population extinction), lead to a shifting geographic dynamic in the coevolutionary process, and ultimately to speciation and diversification.

Seven general classes of local coevolutionary dynamics are identified within Part 1 of the book, along with the forms of selection (e.g., frequency dependent, directional) that drive their coevolutionary outcomes. Part 2 (Chapters 9–16) then examines these seven outcomes of coevolutionary dynamics, which represent the author's categorization of how different types of interspecific interactions lead to various coevolutionary dynamics. For example, Chapters 9–11 explore antagonistic interactions (predation, parasitism, and grazing), which are suggested to result in outcomes of coevolutionary polymorphisms, alternation, escalation, and attenuated antagonism. Chapters 12–14 then examine mutualistic interactions and the outcomes of coevolutionary complementarity and convergence. Chapter 15 considers competition and coevolutionary displacement. Part 2 of the book develops some new ideas (and terminology) for which the reader will benefit from first reading the appendix. While I found that the first part of the book drew fairly clear conclusions from well-reasoned premises and supporting case studies, the second part of the book required some leaps of faith in inductive reasoning. Conclusions in Part 2 may seem tenuous, but the reader should keep in mind that this is one of the first attempts to develop a cohesive framework for classifying coevolutionary dynamics. Part 2 represents a valuable component of the book, as it will stimulate discussions among researchers and guide research on the evolutionary dynamics of species interactions. Part 2 will make this book a thought-provoking read for discussion groups and graduate seminars. Thompson concludes with a final chapter on applied coevolutionary biology, including conservation and management.

As with his prior book, throughout this book Thompson draws upon his command of the literature to present examples supporting his ideas. Yet, given how thorough the bibliography is, it was surprising that there was not more discussion of examples opposing the geographic mosaic of interspecific interactions. Such contrasting case studies and inconsistencies could provide insights into the actual processes of interest. Moreover, little discussion occurs of alternative hypotheses, though this is likely because they are largely lacking. Not every reader will share Thompson's view on the role of coevolution in the ecological and evolutionary dynamics of species interactions. Yet, it is clear that Thompson has again heightened our attention to coevolutionary processes, and certainly to the role of geographic variation in the spatio-temporal dynamics of species interactions. In fact, some readers will be pleased that in many cases, the conceptual framework developed can extend beyond authentic coevolution as defined by reciprocal selection, to provide insights into the evolution of single species resulting from interspecific interactions.

Throughout the book, great emphasis is placed on how differences in the ecological context of interspecific interactions can lead to variation in interaction outcomes, and hence drive the geographic mosaic of coevolution. Many ecological factors are identified to contribute to such variation in interspecific interactions. Yet, there is little to no discussion of the density or abundance of individuals of a population, even though population density is one of the most fundamental attributes of populations contributing to the strength and outcome of interspecific interactions. Variation in outcomes of interspecific interactions due to density dependence could also play an important role in geographic variation in selection mosaics.

*The geographic mosaic of coevolution* not only builds on, but also improves upon, Thompson's prior books. Thompson's evolving view of coevolution presented in this book will be influential, as it raises many questions that will stimulate much research at the interface of ecology and evolution. The author's conceptual framework on the coevolutionary dynamics of species interactions has evolved into a more mechanistically based theory, with explicit predictions and assumptions that can be quantitatively examined through both theoretical and empirical studies. The book includes a discussion of quantitative models of coevolution, while also providing practical ''how to'' suggestions for the empirical study of coevolution. This book should be read by all with interests in coevolution, and warrants reading more generally by biologists with broad interests in evolutionary ecology, species interactions, natural selection, adaptation, and among other topics, spatio-temporal dynamics of natural systems.

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# Spotlight

## Recent Publications of Particular Interest

Beck, Daniel D. 2005. **Biology of gila monsters and beaded lizards.** University of California Press, Berkeley, California. xii + 211 p. $49.95, ISBN: 0-520-24357-9 (alk. paper). These two species of western North America are the only venomous lizards in the world. The chapters in this book address many aspects of the biology of these two species, including their evolution, venom systems, physiological ecology, habitat use, population growth, feeding ecology, reproduction, behavior, and conservation. Terrific photos accompany the text.

Turner, Raymond M., Janice E. Bowers, and Tony L. Burgess. 1995. **Sonoran Desert plants: an ecological atlas.** The University of Arizona Press, Tucson, Arizona. xvi + 504 p. $39.95, ISBN: 0-8165-2519-6 (alk. paper). This book includes descriptions of 339 species that occur in the Sonoran Desert. Each account includes a range map, an elevational profile, and a description that includes information about the species' habitat, phenology, physiology, reproduction, and ethnobotanical and economic uses.

## Books and Monographs Received Through July 2005

Arnqvist, Göran, and Locke Rowe. 2005. **Sexual conflict.** Monographs in Behavior and Ecology. Princeton University Press, Princeton, New Jersey. xii + 330 p. $99.50 (cloth), ISBN: 0-691-12217-2 (alk. paper); $39.50 (paper), ISBN: 0-691-12218-0 (alk. paper).

Beck, Daniel D. 2005. **Biology of gila monsters and beaded lizards.** University of California Press, Berkeley, California. xii + 211 p. $49.95, ISBN: 0-520-24357-9 (alk. paper).

Craig, Patricia. 2005. **Centennial history of the Carnegie Institution of Washington: volume IV: the Department of Plant Biology.** Cambridge University Press, New York. xi + 281 p. $80.00, ISBN: 0-521-83081-8.

Edwards, Andres R. 2005. **The sustainability revolution: portrait of a paradigm shift.** New Society Publishers, Gabriola Island, British Columbia, Canada. xv + 207 p. $16.65, ISBN: 0-86571-531-9.

Ellins, Stuart R. 2005. **Living with coyotes: managing predators humanely using food aversion conditioning.** University of Texas Press, Austin, Texas. 165 p. $30.00, ISBN: 0-292-70632-4 (alk paper).

Gressel, Jonathan, editor. 2005. **Crop ferality and volunteerism.** Taylor and Francis, Boca Raton, Florida. 422 p. $169.95, ISBN: 0-8493-2895-0 (alk. paper).

Grimm, Volker, and Steven F. Railsback. 2005. **Individual-based modeling and ecology.** Princeton Series in Theoretical and Computational Biology. Princeton University Press, Princeton, New Jersey. xvi + 428 p. $99.50 (cloth), ISBN: 0-691-09665-1 (alk paper); $49.50 (paper), ISBN: 0-691-09666-X (alk. paper).

Haccou, Patsy, Peter Jagers, and Vladimir A. Vatutin. 2005. **Branching processes: variation, growth, and extinction of populations.** Cambridge Studies in Adaptive Dynamics. Number 5. Cambridge University Press, New York. xii + 316 p. $95.00, ISBN: 0-521-83220-9.

Leland, John. 2005. **Aliens in the backyard: plant and animal imports into America.** University of South Carolina Press, Columbia, South Carolina. 235 p. $29.95, ISBN: 1-57003-582-2 (alk. paper).

Meshaka, Walter E., Jr., and Kimberly J. Babbitt, editors. 2005. **Amphibians and reptiles: status and conservation in Florida.** Krieger, Malabar, Florida. xvi + 318 p. $66.50, ISBN: 1-57524-251-6 (alk paper).

Nico, Leo G., James D. Williams, and Howard L. Jelks. 2005. **Black carp: biological synopsis and risk assessment of an introduced fish.** American Fisheries Society Special Publication 32. American Fisheries Society, Bethesda, Maryland. xx + 337 p. $60.00, ISBN: 1-888569-68-9 (acid-free paper).

Rundel, Philp W., Robert Gustafson. 2005. **Introduction to the plant life of southern California: coast to foothills.** California Natural History Guide Series. No. 85. University of California Press, Berkeley, California. 316 p. $50.00 (cloth), ISBN: 0-520-23616-5 (alk. paper); $18.95 (paper), ISBN: 0-520-24199-1 (alk. paper).

Sabatier, Paul A., Will Focht, Mark Lubell, Zev Trachtenberg, Arnold Vedlitz, and Marty Matlock, editors. 2005. **Swimming upstream: collaborative approaches to watershed**

**management.** The MIT Press, Cambridge, Massachusetts. xvi + 327 p. $65.00 (cloth), ISBN: 0-262-19520-8 (alk. paper); $26.00 (paper), ISBN: 0-262-69319-4 (alk. paper).

Showers, Kate B. 2005. **Imperial gullies: soil erosion and conservation in Lesotho.** Ohio University Press Series in Ecology and History. Ohio University Press, Athens, Ohio. xxix + 346 p. $55.00 (cloth), ISBN: 0-8214-1613-8 (alk. paper); $26.95 (paper), ISBN: 0-8214-1614-6 (alk. paper).

Taber, Stephen Welton, and Scott B. Fleenor. 2005. **Invertebrates of central Texas wetlands.** Texas Tech University Press, Lubbock, Texas. xi + 322 p. $45.00 (cloth), ISBN: 978-089672-542-3 (alk. paper); $24.95 (paper), ISBN: 978-089672-550-8 (alk. paper).

Turner, Raymond M., Janice E. Bowers, and Tony L. Burgess. 1995. **Sonoran Desert plants: an ecological atlas.** The University of Arizona Press, Tucson, Arizona. xvi + 504 p. $39.95, ISBN: 0-8165-2519-6 (alk. paper).

Vincent, Thomas L., and Joel S. Brown. 2005. **Evolutionary game theory, natural selection, and Darwinian dynamics.** Cambridge University Press, New York. xiv + 382 p. $100.00, ISBN: 0-521-84170-4.

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## ERRATUM

In the paper by A. Tewfik, J. B. Rasmussen, and K. S. McCann (2005), ''Anthropogenic enrichment alters a marine benthic food web,'' *Ecology* **86**(10):2726–2736, an error appears in the Abstract. In the sentence beginning ''The contribution of phytoplankton and associated particulate organic material . . . '' the words ''enriched'' and ''control'' should be interchanged. Thus, the sentence should read ''The contribution of phytoplankton and associated particulate organic material to the SOM was also different, 7% vs. 44% at the control and enriched site, respectively.'' The authors' finding of increased contribution of POM to SOM at the enriched site 2 is correctly presented throughout the main body of the paper.