The biogeographer's paradise

Biodiversity and Conservation of Neotropical Montane Forests

edited by Steven P. Churchill, Henrik Balsev, Enrique Forero and James L. Luteyn

New York Botanical Garden, 1995.
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My first encounter with species richness on a grand scale was on the slopes of Cerro del Torrà, an outlying peak of the Western Cordillera of the Colombian Andes. On a short but memorably arduous collecting trip in the late 1970s, a small team including the late Al Gentry collected more than 300 plant species in less than a week on the slopes of this remote mountain, so poorly known that estimates of its elevation ranged generously from 2500 m to more than 4500 m. This is one of the wetter places on Earth, with annual rainfall of at least 5000 mm supplemented by clouds that almost constantly hug the slopes. After several days of floundering in chocolate orange mud, we reached only 1500 or 1600 m before running out of food and reaching the limit of what we could carry out. Actually, we were never quite sure whether we were ascending the right mountain; the forest cover was so complete and the cloud cover so permanent that we never saw the summit, even from a distance. Around 5% of our specimens turned out to be new species, a proportion that would certainly have increased had we managed to reach the upper slopes.

The western slope of the Colombian Andes forms a relatively small part of one of the most species-rich tropical biomes – the neotropical montane forests, which occupy the cordilleras of the Pacific seaboard from Mexico to Chile, the Caribbean coastal ranges of Colombia and Venezuela, the mountains of the Antilles and the Guayana Highland of the northeastern South American interior. There is great diversity of age among these mountain systems, the tepuis of the Guayana Highland and the cordilleras of the Andes representing the extremes of age and youth, respectively. There has been a complex Pleistocene history of movements of vegetation belts up and down the slopes of these mountains, with concomitant expansion, contraction, isolation and coalescence of species and population ranges.

As a result of this tectonic, geomorphological and climatic dynamism, the region is a biogeographer's and taxonomist's paradise, of which this large book affords just a glimpse. It *is* just a glimpse, albeit an impressive one, for two reasons: first, there aren't enough people working on the subject (at current rates, for instance, it would take another 400 years or so to complete the entire *Flora Neotropica*); secondly, most of the montane forest in the neotropics has been cleared for agriculture.

The Andean forest flora is even more severely threatened than that of most other neotropical regions. Estimates vary, even within this book, as to the amount of neotropical montane forest that has already been lost, but it can be safely said that 75% is a minimum and 80–90% a more likely total. These levels, though shocking, are not surprising. In tropical Central and South America, the cordilleras were a principal site of human population concentration and agriculture in pre-Columbian times, and remained the focus for much of the post-conquest colonization. Destruction has accelerated, as elsewhere, during the present century. Nowadays, the remaining forest areas and fragments owe their continued existence to their inaccessibility, unpleasantness (e.g. permanent cloud cover) and in some cases to conservation measures.

A relatively new threat, documented in two brave chapters in this book, is cultivation of coca and opium. In Colombia, an estimated 500 km^2 of montane forest have been destroyed since 1990 for the cultivation of opium. In 1992, the Colombian anti-narcotics police destroyed nearly 13 000 ha of opium plantation, but by the following year the area under opium cultivation had already increased more than tenfold over the 1991 total; without effective control, it is predicted that most of the remaining forests in the Colombian Central Cordillera, including those in National Parks, will disappear before the end of this century.

This book is mainly Andean and botanical in its focus, concentrating mostly on the forests and flora of Colombia, Ecuador and Peru (and as such it is a good companion to the welcome new edition of Gentry's excellent field guide to the woody plants of this region[1]). Apart from a chapter on the vegetation of Cerro Duida, the tepuis of the Guayana Highland and the Antillean mountains receive little attention. The book contains sections on past vegetation and climate change (Cretaceous to Pleistocene), present vegetation and floristic inventory work, plant taxonomic diversity (including fungi, lichens and bryophytes), human impacts on the montane habitat, and conservation. In a welcome departure from many multi-author volumes on tropical biology, this one contains plenty of contributions from the countries concerned.

The section on floristic inventory draws together much of the recent work that is beginning to allow comparative quantitative analyses of diversity across different montane sites, as well as more-detailed distribution maps for individual taxa. A posthumous chapter by Gentry, one of the pioneers of this approach, summarizes data on more than fifty 0.1-ha sites above 800 m in the Central and South American cordilleras, demonstrating consistent patterns in diversity and floristic character with elevation. He concludes that, in the South American Andes at least, plant species diversity in montane sites up to 1500 m is no less than in lowland rain forest. Inventory work of this kind, both inside and outside National Parks, has become an urgent priority in the identification of key areas for conservation, and requires the training of many more systematists and ecologists in field identification of sterile material.

There is also a chapter on the results of more recent explorations of Cerro del Torrà which has continued to yield new species (the true elevation of the mountain turns out to be a modest 2800 m). In the course of three expeditions, botanists from the Universidad del Valle, Cali, Colombia, collected almost 500 species, a further 5% of which were definitely new (and a still greater proportion yet to be determined). Much of the western slope of the Colombian Andes remains uncollected: what more might it yield? Less than 4% of the forests of the western slope Ecuadorian Andes remain intact; what might they have yielded?

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References

1 Gentry, A.H. (1996) *A Field Guide to the Families and Genera of Woody Plants of Northwest South America (Colombia, Ecuador, Peru) with Supplementary Notes on Herbaceous Taxa*, University of Chicago Press

Subterranea incognita

Fundamentals of Soil Ecology

by David C. Coleman and D.A. Crossley, Jr

Academic Press, 1996.
$35.00 hbk (xv + 205 pages)
ISBN 0 12 179725 2

Soil ecology is a broad field with no universally acknowledged canon. To some, it probably appears as a mosaic of disjointed interests and approaches from molecular to global scales. But perhaps it is better viewed as a subdiscipline of an even broader field: ecosystem ecology. In the ecosystem view, researchers emphasize the interlinked nature of physical and chemical processes on the one hand with biotic processes on the other, including all of the feedbacks and attendent complexity that those interactions

suggest. Soils are particularly well suited to this perspective as a context for the study of organisms and processes. The very mineral grains play critical roles in soil systems, through exchange of ions, retention of liquids, sorption of organic colloids, and the establishment of a three-dimensional matrix of habitats.

A schism exists among ecologists between the 'population-community view of ecosystems and the process-functional approach'[1]. At national meetings, it is easy to avoid presentations that use one or other approach because they are conveniently segregated. This book represents a notable and sorely needed effort to bridge the gap. Coleman and Crossley bring their extensive knowledge of soil fauna to the functional ecosystem view, which is rare and provides the greatest strength of this book. Researchers from each camp will learn things about the other camp that will be relevant and new to them.

At the core of this text is a thorough chapter on soil fauna that include representatives from all terrestrial phyla. The artwork is high quality, including anatomical drawings of protozoa, a eutardigrade, an enchytraeid worm, nematodes, and a lumbricid earthworm. The soil is a frontier for studies of biodiversity: 95% of all bacterial species and 90% of all fungal species may remain unknown at present, while probably >100 000 species of oribatid mites await classification.

Although the authors write about fauna and food webs with the greatest authority, their expertise and the topics they cover extend much further. Discussions of methodology range from the measurement of enzyme and microbial activities to root production and detrital decomposition. The soils primarily covered are those in forests, agroecosystems and grasslands. Overall, the approach is more applied than theoretical. A brief introduction to modeling carbon and nutrient cycles is included. The citations in the reference list provide a highly useful mix of primary literature, historical or landmark papers, and other books and chapters.

In a slim volume written on a broad subject, important topics are bound to be overlooked. One such omission in this case regards humification and the functions of humus. Processes of humus formation are not covered, though soil carbon stocks, carbon sinks and their roles in global change are emphasized in the final chapter. Humic compounds are mentioned parenthetically at several points, but the treatment lacks consistency. The 'complete list of influences of soil biota' (p. 163) on soil structure unfortunately refers only to soil fauna. Elsewhere, humic materials equated with microbial and fungal debris are listed as a major binding agent in microaggregates (p. 15). The authors also state that the build-up of humic-like substances can impede microbial activity. While this may be true in terms of allelochemic interactions, it is also true that a build-up of humus increases the specific surface area of a soil, its moisture retention and its nutrient retention capacity – effects that should benefit microorganisms.

Though this book was not developed as a primary or basic text for a course, ecology instructors will find it rich in topics for discussion. It is intriguing that populations of predatory nematodes appear to be controlled by primary production, whereas populations of grazing nematodes apparently are not, or that mite populations follow a successional sequence in step with a succession of fungi during decomposition of leaf litter. Coleman and Crossley intended this book 'primarily as a source of ideas and concepts and thus ... as a supplemental reference for courses in ecology, soil science, and soil microbiology.' However, they have written a book that researchers in the field will also find useful as a source of ideas. They have made an essential stride toward synthesizing the results of widely varying approaches to research.

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References

1 O'Neill, R.V. *et al.* (1987) *A Hierarchical Concept of Ecosystems*, Princeton University Press

Magnifying selection

Ecological and Evolutionary Aspects of Insecticide Resistance

by John A. McKenzie

Academic Press, 1996.
£52.00 hbk (185 pages)
ISBN 0 12 484825 7

The development of insecticide resistance can be viewed as evolution seen under a microscope, particularly regarding the clarity and detail with which selective processes can be studied. This is one of the central themes of John McKenzie's brilliant new synthesis of studies on insecticide resistance. Unlike recent[1] and forthcoming[2] edited volumes on the ecological genetics of resistance that have numerous contributors, the strength of this book is that it has been written by a single author, drawing on a lifetime's worth of work in the field. The book updates us on the progress made since the seminal review of Roush and McKenzie in 1987 (Ref. 3). I have little doubt that this book will quickly become a classic, and I recommend it as a must for anyone interested in the mechanics of natural selection.

The book starts simply at the level of the phenotype and takes us to the cutting edge of resistance studies in less than 200 pages. It is clear, precise and can be read in a single sitting (a privilege I normally only reserve for books of a very different nature). And so, the book achieves another of its main aims, to be accessible to interested readers outside the field. Thus, it emphasizes the role that an applied topic can bring to understanding the fundamental processes of natural selection. The text centers around three main themes: (1) the genetic basis of resistance and the current impact of molecular techniques; (2) how selection acts on resistant genotypes; and (3) the application of this knowledge to the management of the problem.

The section on the mechanics of selection is particularly lucid and brings together many of the current concepts in the literature. From the impact of pesticide decay curves, to the fitness of genotypes in the presence and absence of selection, an unbiased and wide-ranging review is given. Many pertinent examples are used, including McKenzies's own work on Australian sheep blowfly and the resistance management strategies employed in Australia and the US for management of lepidopteran (Helicoverpa and Heliothis) pests of cotton. Emphasis is placed on the difference between selection within and outside of the phenotypic distribution, providing clarification of a concept that has confused the literature on selection of resistant strains for decades. In examining the genetic and molecular basis of resistance, the recent impact of molecular biology is stressed. The questions highlighted are at the forefront of current research. For example: what are the mutations that underlie resistance? How often do they arise in global populations? Is *Drosophila* a useful genetic model for pest insects? Finally, McKenzie weighs up the impact of our knowledge on the problem, and highlights future areas that he thinks are critical to further research in the field. His own pioneering studies, on proving that laboratory mutagenesis and selection outside of the wild-type phenotypic distribution is a reasonable way to predict resistance mechanisms to novel compounds before their introduction into the field, are notable landmarks.

In short, I can find little wrong with this book. You will not like it if you are a quantitative geneticist as it rests heavily on the proven premise that resistance associated with control failures is largely mono- rather than polygenic in nature. And if you are an earnest student of the field, you may think it is a bit short. However, the bibliographies at the end of each chapter list all the current