Book Reviews

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Tropical forest ecology comes of age

Carson, Walter P., and Stefan A. Schnitzer, editors. 2008. **Tropical forest community ecology.** Wiley-Blackwell, Malden, Massachusetts. xvii + 517 p. $79.95 (cloth), ISBN 978-1-4051-8952-1; $20.00 (paper), ISBN 978-1-4051-1897-2.

Key words: biodiversity; community ecology; conservation; succession; tropical rain forest.

The "tropics"—that area of the globe between the Tropic of Cancer and the Tropic of Capricorn—hosts the majority of the planet's biological diversity and the bulk of the world's nearly seven billion inhabitants. The former, along with its always startling natural history, its bewildering array of interspecific interactions, and its evolutionary novelties, attracts ecologists like flames attract moths. The latter, historically disdained by ecologists studying obscure organisms in pristine sites, will determine the fate of the former. And like most texts and edited volumes about ecology and ecological processes, *Tropical forest community ecology* paints ecological theory and observations strongly but integrates humanity into the picture only weakly, and only at the final edges.

Five of the book's six sections, and 24 of its 28 chapters provide a reasonably up-to-date (mostly through 2005) synopsis of the current understanding of determinants and drivers of plant species diversity in tropical (mostly wet) forests; secondary succession well beyond the gap-dynamic paradigm of the 1980s; herbivory; and tri-trophic interactions. The reader is treated to a predictable discussion of the relative merits of neutral theory, niche partitioning, and competition-colonization trade-offs that would have benefited from more attention to post-2005 literature on these topics (Jérôme Chave seems to be the only author in the volume to have taken advantage of the opportunity provided by the editors to update his chapter prior to final publication). There is a wealth of natural history (Elizabeth Arnold's overview of tropical endophytic fungi is a standout here), and Lee Dyer emphasizes its importance for tropical ecologists hoping to ever make sense of the wide range of interactions and processes they observe.

But the chapters that really shine are those that not only bring ecological theory to bear on the astonishing natural history but also explicitly make comparisons between temperate and tropical systems. Paul Fine and his colleagues use a modern geographic age and area hypothesis to link patterns of plant species diversity between tropical, temperate, and boreal biomes. Walter Carson and his colleagues contrast temperate and tropical forests in their review of data that address the Janzen-Connell hypothesis that density- and distance-dependent natural enemies regulate plant populations and enhance local species richness. Chris Peterson and Walter Carson compare temperate- and tropical-based models of old-field succession. Synthetic work like this suggests that there really may be general theories for ecology, not taxon-, habitat-, or biome-specific theories leading to an endless stream of unrelated case studies.

The chapter authors and editors, however, missed an opportunity to better integrate ecology and conservation in tropical forests. In his Foreward, S. Joseph Wright accurately captures the excitement of tropical ecology, but goes on to note that "the final section of this volume [the four chapters on forest conservation] would shock a 1970s graduate student" (i.e., when he himself was a graduate student), as he asserts that what we now think of as the "tropical deforestation crisis" was only first publicized in the 1970s and that "the severity of deforestation in 2007 and the many exacerbating problems would [have been] entirely unexpected." Methinks he doth protest too much. First, ecologists have long recognized a tropical deforestation crisis in the offing; for example a quick glance at the final two chapters of the 1952 classic *The tropical rain forest: an ecological study* by P. W. Richards (Cambridge University Press, New York) shows that deforestation was already an issue more than half a century ago. But graduate students then, in the 1970s, and now, are, as Francis Putz and Pieter Zuidema note in their chapter, not rewarded for taking on unwieldy interdisciplinary projects linking ecological issues with sociopolitical and cultural challenges. And a graduate student in 2009 reading either Richard's *The tropical rain forest* or Carson and Schnitzer's *Tropical forest community ecology* still could be forgiven for turning to the chapter of greatest theoretical interest (perhaps Egbert Leigh's homage to mathematics with a crystal clear set of hypotheses and predictions designed to undergird dozens of dissertations) but never reaching the last section and thus continuing to ignore the human dimensions of tropical ecology.

Perhaps future volumes on tropical ecology and conservation will talk about how the world-wide network of 50-hectare plots not only provides opportunities to test explanations for the maintenance of tree species diversity (described in the chapters by Jess Zimmerman and colleagues, and Stephen Hubbell) but also discuss how this network is building intellectual capacity in-country and providing tangible evidence that setting aside reserves provides local economic benefits. Or that islands left behind large locks and dams not only provide tests for theories of island biogeography and top-down versus bottom-up control (discussed in chapters by John Terborgh and Kenneth Feeley, and Gregory Adler) but also relocated populations, upended economies, and destroyed indigenous cultures. But for now, readers will learn from Thomas Kursar and colleagues that bioprospecting can benefit Panama (or at least it could before the global economic collapse), and that rainforests are being fragmented, cleared, and burned at an appalling rate (chapters by Richard Corlett and Richard Primack, and William Laurance). Putz and Zuidema rightly note that ecologists, by focusing on the natural history, the elegant theory, and the last remnant "undisturbed" sites contribute little to actual conservation, which requires working to alleviate poverty, create economic opportunities, and evolve new structures of governance. But in a world of seven billion, soon to be 10 billion people, such work may take too long and leave us only with urban parks, buffer zones without intact cores, and managed monocultures or low-diversity "multiple-use" forests. Certainly there is ecology in these human-dominated landscapes, and in twenty years perhaps we will know if it is the same ecology that we once studied in our "pristine" sites. *Tropical forest community ecology* may turn out to be the elegy for rainforest ecology, or it may be the harbinger of things to come. Only time will tell, but meanwhile there is much work to be done, and *Tropical forest community ecology* provides useful directions.

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Thawing, browning, burning—the boreal forest of the 21st century

Hari, Pertti, and Liisa Kulmala, editors. 2008. **Boreal forest and climate change.** Advances in Global Change Research. Volume 34. Springer, New York. xxix + 582 p. $239.00, ISBN: 978-1-4020-8717-2 (acid-free paper).

Key words: boreal forest; climate change; ecosystem process modeling; scaling.

Boreal forest ecosystems have become the subject of much interest in recent years as the influence of climate change has become more pronounced, modifying fire disturbance regimes (burn severity, timing, and extent), altering vegetation growing season initiation and duration, changing the magnitude and trends of plant productivity, increasing the depth of seasonal thaw and mobilization of deep carbon, and, as a result of these processes, altering the balance of carbon and energy exchange. A great many peer-reviewed papers and a half-dozen edited book compilations have addressed these topics in the past decade. Some of the most compelling changes taking place in boreal ecosystems have been documented using a combination of satellite and field observations, and perhaps the most noted of these is what has become widely referred to as the "greening of the north." Satellite indices of vegetation photosynthetic activity indicated a systematic increase over the decade since consistent global satellite coverage started in 1981.

After 1991 and particularly after 1999, however, an interesting divergence took place across the circumpolar high northern latitudes. Tundra vegetation continued a now-26 year greening trend but most boreal forest areas no longer continued greening, and many areas showed declines in photosynthetic activity (so called "browning"). The denser the forest cover in these areas, which had not burned within at least the past 50 years, the greater the browning trend. The declines are particularly apparent in late summer months when drought stress is greatest. Comparisons with meteorological measurements, tree rings, and modeling studies confirm that the boreal forest is showing the impacts of drought stress, in the form of anomalously high vapor pressure deficits—not something that was considered typical of high latitude forests.

Additional analyses confirmed another compelling example of change taking place across North America's boreal forest, particularly in Alaska and western Canada. The extent, seasonality, and severity of burning were producing changes in the composition of tree cover, with more deciduous regrowth replacing the previously conifer-dominated forests. The extent and frequency of more severe fires resulted in greater consumption of organic matter, and deciduous vegetation was flourishing on mineral soils that were exposed from beneath centuries-old peat deposits that had burned off. In these areas, a more deciduous and more productive vegetation cover was sharply contrasted with the declining productivity of yet unburned forests suffering the impacts of drought. Greater depths of active layer thawing add yet more change to the now-dynamic mix, with some areas becoming drier, more prone to fire, and losing surface ponds to drainage—while other more poorly drained areas became wetter and formed new ponds. All of these changes have been documented over great geographic extents, yet changes taking place at any given location in the boreal biome can be quite different from those in another location just a few kilometers away.

In this context, it is difficult to generalize measurements taken at a given boreal forest site, yet such measurements are essential to our understanding of the processes driving change and the knowledge needed to develop robust models of the processes involved. This is particularly true given the relative lack of intensive, systematic, long-term measurements in boreal environments, which is why *Boreal forest and climate change* is a much-needed addition to the literature on the subject. The book is focused on a now-three-decade record monitoring and modeling processes and exchanges among vegetation, soil, and atmosphere at sites across Finland. Nominally organized around a set of theories (a "metatheory") dealing with these efforts in the context of climate change, the book provides detailed, nicely illustrated insights into both conceptual and mechanistic process models describing aspects of these theories and associated processes, their interactions, and scale dependence.

Aside from the relatively brief introductory and concluding chapters, there are nine substantive well-cited sections dealing with the overall methodological approach (field measurements, statistical methods, process modeling), environmental factors (their temporal and spatial variability), transport (molecular, convective, radiative), aspects of structure (in vegetation, soil, and atmosphere), physical and chemical processes (in vegetation and soil), scaling of processes and transport, connections among structure, processes, and transport, a mechanistic model of forest growth (MicroForest), and finally (as per the book's title) the interactions and feedbacks between boreal forests and climate change. One of the two editors (usually Pertti) co-authored each section, and all of the contributors to the book are forest ecologists and physicists based at the University of Helsinki. This close connection, which evolved over several research generations of collaboration with Soviet counterparts, grew out of initial measurements and forest growth model