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book review

Tackling thorny issues in seasonally dry tropical forests

The ecology and conservation of seasonally dry forests in Asia, by William J. McShea, Stuart J. Davies and Naris Bhumpakphan (editors)

2011, Smithsonian Institution Scholarly Press, 418 pp. ISBN: 978-1-935623-02-1

Price: \$69.95 / £44.95 (Hardback); <http://www.scholarlypress.si.edu/>

Seasonally dry tropical forests: ecology and conservation, by Rodolfo Dirzo, Hillary S. Young, Harold A. Mooney and Gerardo Ceballos (editors)

2011, Island Press, 391 pp. ISBN: 978-1-59726-703-8/978-1-59726-704-5

Price: \$95.00 (Hardback)/\$50.00 (Paperback); <http://islandpress.org/>

The first difficulty in reviewing (and I presume writing) any book on seasonally dry tropical forests (SDTF) is to come to some understanding as to what SDTF actually are. I hazard a guess that what is a seasonally dry tropical forest to one person is a seasonal rain forest to another. I myself have recently treated 'seasonally dry tropical forest' formations as various types of 'seasonal rain forest' (Ghazoul & Sheil, 2010). What is clear is that aseasonal tropical wet forests grade almost imperceptibly into seasonally dry evergreen forest, variably deciduous forest and, ultimately, xerophytic woodland at the other extreme. Imposing clear-cut system definitions is always going to be problematic, but it is the nature (and necessity) of human enquiry to impose some sort of classification system on hopelessly complex realities. In this vein two recent edited books on Neotropical (Dirzo et al.) and Asian (McShea et al.) forests define SDTF as tropical forests with predictable, regular dry seasons lasting 4-6 (Neotropics) or 2-6 months (Asia), while also recognising variations on this theme. It is not so much the duration or intensity of the dry season that matters, but rather the seasonal water stress that plants are subjected to, and this is as much a function of local topography, soil and disturbance history as it is of climate. Thus in Asia SDTF can occur alongside wet evergreen formations in a mosaic of different vegetation types, adding to the complexities of distinguishing and mapping SDTF.

Both these books begin similarly, with a couple of chapters on floristic composition and biogeography of seasonally dry tropical forests in each respective region. In the Neotropics Linares-Palomino et al. identify close floristic affinities

among isolated SDTF regions that are distributed across a formerly hypothesised 'Pleistocene Arc' of SDTF that extends from Argentina in the south through Paraguay and across Brazil in the north. The Andean dry forests might represent an extension of this arc, although the data on this point are ambiguous. Yet these authors argue that there is little evidence for a wide-ranging Pleistocene SDTF formation, citing long-distance dispersal events to explain the distribution of widespread species. The floristic ordination of continental Southeast Asian SDTF conducted by Bunyavejchewin et al. separates formations by elevation, topography, soil chemistry and soil physical features, all of which are related to soil water-holding capacity, as well as the length of the dry season. A striking feature of SDTF and other tropical forests in Asia is their abundance of trees belonging to the Dipterocarpaceae, yet some formations (e.g. mixed deciduous forests and lower montane forests) are notable by the near absence of dipterocarps. A biogeographic approach might provide some insights into such patterns because the Asian mixed deciduous and lower montane forests are dominated largely by families that are thought to have warm-temperate Eurasian origins (e.g. Fagaceae, Lythraceae), while the dipterocarps originated in the southern hemisphere (Gondwana) and colonised the Asian tropics via India's collision with Asia around 50 Mya. A fascinating chapter on the evolution of dry forest gingers by John Kress is unfortunately not placed in the context of the distribution of forest formations outlined in the earlier chapters.

The central defining feature – a predictable dry season – shapes phenological, behavioural,

physiological and functional attributes of seasonally dry tropical forests and their constituent species. This has seemingly given rise to exceptional beta diversity (particularly of plant taxa) and many endemic species, an issue that both books emphasise in several chapters. Seasonality also exposes SDTF to fire, a topic that receives rather more treatment by McShea et al.'s Asian focus in which fire disturbance as well as its management (e.g. chapters by Wanthongchai & Goldammer, and MacInnes) are explored in some detail. Unlike Neotropical SDTF, fire is a natural feature of many Asian SDTF, but also has anthropogenic origins, having been used for centuries to clear land for agriculture. Sanchez-Azofeifa & Portillo-Quintero argue that, in the Neotropics, fire is purely anthropogenic, and is treated as such by Garcia-Oliva & Jaramillo in their evaluation of biogeochemical processes in transformed SDTF. To what extent physiological and ecological differences between American and Asian SDTF have been shaped by the occurrence (or absence) of natural fire regimes remains an open question for which a comparative treatment is needed.

Both books have a series of chapters describing the animal richness of SDTF, but here the similarities end. Dirzo et al.'s volume includes chapters on soil diversity and functioning, insect diversity, and an interesting chapter on mammalian responses to seasonal patterns, but almost no mention of birds (which makes the cover photo of a Military Macaw a little perplexing), nor amphibians or reptiles. Chapters in McShea et al., by contrast, do cover birds, amphibians and reptiles, as well as seven chapters on specific mammalian species, but ignore invertebrates. Yet none of the seven chapters on mammals in McShea et al. has anything to say about bats or rodents, the most species-rich mammalian groups. In my opinion, both books are unbalanced in these respects.

It is the seasonal water scarcity of SDTF that sets them apart from most rain forests, and so naturally there is much interest in understanding how different animal communities respond to seasonal changes in water and resource availability. Excellent chapters on this topic are found in both books, with Stoner and Timm reviewing

Neotropical mammal behavioural and physiological adaptations to seasonality, and Brockelman doing the same for Asian gibbons. The manner in which animals track and use the available resources (e.g. forage and fruits) at different times of year can have ecosystem impacts. For example, ungulates (and elephants) affect fire regimes by altering the forest plant species composition, and the decline in numbers of these species from SDTF is likely to affect ecosystem functioning. The cascading effects of ungulate declines on their predators, as well as on vegetation and ecological processes, is an interesting and important topic that is alluded to in several chapters, but really should have been developed further in both books. A functional approach re-emerges in Dirzo et al. with three useful chapters on primary productivity and biogeochemistry, leaf turnover and production, and water dynamics relating to seed dispersal and seedling establishment, all explored in the context of the seasonal water availability and rainfall regimes.

The last few chapters of Dirzo et al. provide reviews of the changes wrought by human transformation of seasonally dry tropical forests on biogeochemical and plant reproductive processes, biodiversity and ecosystem services. Both books emphasise that clearance and fragmentation of SDTF for agricultural purposes, coupled with uncertain future impacts of climate change, threaten the rich biodiversity that SDTF contain, and the services they provide. Chazdon et al. provide reasons to be optimistic about the conservation of biodiversity in Neotropical agricultural landscape mosaics, while being realistic about the challenges. Although this 'countryside biogeography' concept is now widely familiar, the book would not have been complete without it. A case study on community-based management for forest resources by Peters complements this conceptual approach. McShea et al.'s volume concludes with a series of case studies on the use and management of SDTF and their resources by local communities in Myanmar, Nepal and Cambodia.

Seasonally dry forests have been substantially cleared, degraded and fragmented, but climate change might shape the distribution of SDTF

in the long term. While many SDTF species are likely to be resistant to climatic changes on account of their tolerance of seasonally wet and dry conditions, Meir and Pennington (in Dirzo et al.) suggest that SDTF expansion into Amazonian rain forest regions under future drying scenarios is likely to be limited by the Amazon's poor soils. Climatic and ecosystem transitions in South America remain highly uncertain, but it could be that the relatively species-poor cerrado savanna woodlands are the ultimate beneficiaries of climate change, to the cost of rain forests and SDTF.

Missing from both books is some discussion of how invasive species have affected composition and ecological processes within SDTF. *Lantana camara* has, for example, substantially altered species composition, seedling dispersal, biogeochemical processes and disturbance regimes (among other things) in SDTF (Aravind et al. 2010, Berry et al. 2011, Sharma & Raghubanshi 2009), at least in Asia and Australia. In the Neotropics the establishment of honeybees (*Apis mellifera*) has possibly altered plant reproductive patterns and pollination services, an issue that is acknowledged but not elaborated by Quesada et al.'s otherwise excellent chapter on pollination.

Presentational quality is mostly high, with plenty of supporting tables and figures (though a few of the latter lack sufficient clarity), but would have benefitted from the use of more photographs. In both books, other than a single chapter in each, there are no photographs at all. Actually this is not quite true, because McShea et al. do include at the centre of the book several consecutive colour plates of forest formations, gingers and various mammals, but these are not obviously cited by the chapter texts and some are redundant—there is, for example, little need for three photographs of dry deciduous dipterocarp forest, particularly when three subsequent photos show people collecting various non-timber forest products in the same forest type.

In conclusion, both books provide a much-needed overview of seasonally dry tropical forests in their respective regions. It is perhaps true that rain forests generally receive the lion's share of researcher and conservation attention, but SDTF

are no less fascinating, and equally in need of conservation intervention. Despite some shortcomings in each, I am sure that both books will be foundational texts for conservation managers and students alike. Overall, I enjoyed reading both, but preferred the greater emphasis on ecosystem properties, processes and function in Dirzo et al., although the latter probably benefitted from the greater availability of published material in this region. One quibble is that the title should really have indicated its Neotropical focus. In any case, I now look forward to reviewing a book on African seasonally dry forests, should anyone care to write it.

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