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Open Ecosystems: Ecology and Evolution Beyond the Forest Edge

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By William Bond

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Background

This book represents the pinnacle of research outputs by author William Bond and strongly reflects his long standing passion for non-forested, open ecosystems ecology. For decades, Bond aspired to solve ecological problems (Leonard 2012), and this insatiable curiosity has shaped him into an internationally acclaimed plant ecologist. In his latest book, he challenges global misconceptions on the antiquity of natural open ecosystems, which have led to poorly conceived global policies to reforest them (Silveira et al. 2020). Furthermore, the content of the book challenges long-held concepts in ecology, biogeography and paleoecology, but with remarkable scientific evidence and support across the global extent of open ecosystems. With no surprise, the author's extensive knowledge of and interest in fire as key driver of vegetation dynamics features across all sections related to fundamental questions of where, why and for how long open ecosystems occur side-by-side with closed forest ecosystems.

Open ecosystems (OEs), in the context of this book, refer to all grasslands, savannas and shrublands globally, which occur in climates that are warm and wet enough to support closed forest ecosystems, and yet they are not forests, and certainly do not represent anthropogenically induced degraded forests. The aim of the book is to present general explanations for the existence of OEs. Providing authoritative support for their existence is envisioned to assist in the differentiation between ancient old-growth, and secondary OEs, which are products of deforested landscapes. Proper differentiation between ancient and secondary OEs is critical in the current ecological restoration age where several internationally supported policies and funding bodies are engaged with global afforestation campaigns. Such restoration plans expand deeply into ancient OEs worldwide due to general misconceptions on the antiquity and ecological functioning of these fascinating uncertain ecosystems (Bond 2016). In my view, the book provides a strong base that allow ecologists to acquire further evidence to support the existence, evolutionary history, ecological functioning and biogeography of OEs. For an expertly conducted technical review of the book, see O'Connor (2019).

Content of the book

The book contains nine chapters, full references as well as an index to key words and key concepts, which facilitate quick referencing to particular topics when using a hard copy. The introductory chapter sets out a general explanation of OEs, supported by Fynbos shrublands as an example, presumably due to the author's deep interest and research experience in this ecosystem type. The introduction chapter is well-structured and includes the scope of what will be covered. Not only is the reader well prepared on OE ecology, which is provided through a strong overview of the history of global ecological research, but current advanced technologies and contemporary ecological theory are introduced, and their value and application highlighted for future support of OEs' existence. Four ensuing chapters respectively explain climate patterns, ecological drivers, vegetation dynamics and evolutionary history of OEs and how these are interrelated to a central explanation of the antiquity of non-forested OEs.

The 'climate-physiognomy classification of vegetation' assumption is challenged in the first chapters of the book. Taking the reader through examples of vegetation–climate correlation studies from the tropics, to temperate and boreal ecosystems, the book introduces the origin of a common fallacy that OEs are degraded forests. Although not being elaborated upon much, the author agrees that climate extremes, such as drought and frost, seem to be more important than average climate conditions in explaining OE structuring. Climate is only but one of the ecologically important drivers being discussed in detail. Soil properties, which are discussed in more detail later in the book (Chapter 6), are presented as another traditional explanation for OEs. From a summary section in this chapter, research on below-ground processes and plant-soil feedbacks seems to be limited. Yet, there seem to be no fixed, optimal explanation of ecosystem ranges based on basic drivers, such as climate and soil alone, as some ecosystems associated with certain climates and substrates may support multiple stable states. For this reason, the book introduces the reader to unconventional explanations of OEs, such as large-scale consumer control, including fire (Chapter 7) and vertebrate herbivory (Chapter 8) in the context of alternative stable states. Well-structured discussions on each of the above, supported with examples from different continents, are captivating, as they broaden the ecological understanding of OEs.

Providing a convincing explanation for the evolutionary origin of OEs remains challenging. This book, particularly Chapter 5, presents an informative evolutionary background of OEs. What I found particularly interesting, was the role of long-term interactions, such as climate and CO_2, with consumers such as mammals and fire, in shaping current OEs. Since these interactions are complex and dynamic, I feel a single, explanatory diagram indicating clear distinctions and overlaps of all evolutionary drivers and consequences across geological time, would have been a valuable addition to Chapter 5 to summarise the in-depth context.

To me, Chapter 4 ('The nature of open ecosystems') was the most intriguing read in the book. Through global perspectives of OEs' diversity, endemism, antiquity and functional adaptations, this chapter provides a concise summary of the origin and extent of the exceptionally rich nature of OEs. The final chapter not only summarises the key threats to OEs in the context of global change, but particularly highlights important knowledge gaps and opens up new research questions and perspectives. This has already inspired a research agenda for the restoration of OEs (Buisson et al. 2020).

Overall, the book has few weaknesses. *Open Ecosystems* was a fascinating read, packed with authoritative evidence, personal observations and experimental support across the globe. The content makes out, and often challenges, a solid body of past and novel ecological hypotheses, presented in a rather coherent manner. The ultimate strength of this book is that it clearly defines research gaps and provides important guidelines for future research aimed at an improved understanding of OEs. Building upon such foundations, OE ecologists are better equipped to motivate for the conservation of its biodiversity, function and services beyond quick-fix attempts to combat global climate change.

The book showcases OEs as ancient ecosystems, persisting for millennia through creating their own preferred environmental conditions. Someday, I think, the world will 'lift their heads in awe at the ways in which life is organized as a collective in diverse parallel worlds' – quoted from Chapter 3 (section 3.10, p. 42). The responsibility now lies on current and future OE ecologists to change the aftermath of the very last sentence of this book 'Maybe it is not too late', to 'It came at the right time and surely was not too late'.

Disclaimer: This article was not peer reviewed.

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