R.J. Hobbs and K.N. Suding (Eds.) New Models for Ecosystems Dynamics and Restoration.
Island Press, Washington D.C., USA. 2009, 352 pp, ISBN-13: 978-1-59726-184-5 (cloth); ISBN-13:978-1-69726-185-2 (paperback); 26 cm; maps, illus.

The ‘new’ models referenced in the title of this contribution to The Science and Practice of Ecological Restoration book series are ‘threshold’ or ‘regime shift’ ecosystem models. *New Models for Ecosystems Dynamics and Restoration* aims to examine when and where these models have been used, what evidence is used to derive and apply them, and how effective they are for guiding management. Opening with six conceptual background chapters that lay the foundation for 14 subsequent case studies, and rounding up with a final synthesis chapter, the book provides some interesting summaries and examples of the current state of theory and practice in threshold modeling for ecological restoration. As usual with books structured in this manner, it is unlikely that every case study will be of interest to all readers, and landscape ecologists may consider the limited consideration of space, scaling, and human-environment feedbacks a shortcoming.

Threshold models are ‘new’, the editors argue, in the sense that they contrast gradual continuum models and stochastic models. Gradual continuum models are those that assume post-disturbance ecosystem recovery follows a continuous, gradual trajectory towards some single equilibrium state. Stochastic models assume exogenous drivers dominate the behavior of ecosystems to the extent that non-equilibrium and unstable systems states are the norm. In contrast, threshold models assume there are multiple stable ecosystem states and represent changes from one relatively distinct system state to another as the result of small changes in environmental (driving) conditions. Two types of threshold model are considered in *New Models*: i) state-and-transition models that represent multiple (often qualitative) stable states and the potential transitional relationships between them, and ii) alternative stable state models which are a subset of state-and-transition models and generally represent systems with fewer states and abrupt transitions (flips) between the alternative states.

The background section of the book provides an excellent introduction to key concepts and approaches in threshold models for ecosystem dynamics and restoration. Two background chapters address models and inference, two introduce transition theory and dynamics in lake and terrestrial ecosystems, and two discuss issues in social-ecological and rangeland systems. These chapters are clear and concise, providing accessible and cogent introductions to the systems concepts that arise in the later case studies. They will likely be of use in undergraduate teaching as introductory material for their respective topics.

Equally concise, the case studies present research and practical examples of threshold models in a range of ecosystems types – from arid, grassland, woodland and savanna ecosystems, though forest and wetland ecosystems, to 'production landscapes' (e.g., restoration following mining activities). As the editors highlight in their final synthesis, the majority of these case studies present conceptual rather than mathematical models and few use experimental data. Human activity and spatial process are often implied (e.g., human land use legacies and seed sources respectively), but landscape ecologists may be disappointed that the case studies do not do more to investigate points raised in the background chapters on social-ecological and rangeland systems.

For example, in their background chapter King and Whisenant highlight that many previous studies of thresholds in social-ecological systems have investigated an ecological system driven by a social system, ignoring any feedbacks to the social from the ecological. Although explicitly modeling feedbacks between social and ecological systems remains a daunting task, this representation is absent from the book's case studies. The editors themselves highlight that detailed consideration of social systems is beyond the scope of the book and that such issues are addressed elsewhere (including in other volumes of this book series such as Aronson *et al.* 2007). Representing human-environment feedbacks is becoming increasingly vital to ensure appropriate understanding of many environmental systems however, and their omission here may prove unsatisfactory to some.

A second shortcoming of the book, from the perspective of a landscape ecologist, is the general lack of consideration in the case studies for spatial pattern and scaling and their influences on ecosystem processes. In their background chapter on resilience theory and rangelands, Bestelmeyer *et al.* do highlight the importance of a landscape perspective and considering patterns of landscape states, but only a single case study really picks up on these concepts in earnest (Cale and Willoughby). Although other case studies indirectly consider spatial feedbacks and landscape context, explicit representation of relationships between spatial patterns and ecosystem processes is neglected.

However, these criticisms need to be considered in light of the objective of *New Models* – to collectively evaluate threshold modeling approaches as currently applied to ecological restoration. In their synthesis chapter, the editors highlight that the models presented in the book have been used heuristically with little testing of their assumptions and ask; *"Does this indicate an obvious gap between ecological theory and restoration practice?"* For example, in their chapter on conceptual models for Australian wetlands, Sim *et al.* argue that the primary value of threshold models is to provide a conceptual framework of how ecosystems function relative to a variety of controlling variables. The editors suggest the case studies indicate that restoration practitioners are applying models that work, rather than "striving to prove particular elements" (of system function or ecological theory), and that maybe this isn't such a bad approach given pressing ecological restoration needs.

Potentially, this is a lesson: if landscape ecologists are to provide ecosystem managers and stewards with timely advice they may need to need to scale-back (i.e., reduce the complexity of) their modeling aims and objectives. Alternatively, we could view this situation as an opportunity for landscape ecologists to usefully contribute to advancing the field of restoration ecology. Most likely it is indicative that where practical knowledge is needed quickly, simple models using established ecological theory and modeling tools are most useful. But in time, as our theoretical understanding and representation of spatial and human-environment interactions advances, these aspects will be integrated more readily into practical applications of modeling for ecological restoration.

New Models contains chapters of conceptual interest for the study of ecological, restoration, but many landscape ecologists may be disappointed by a lack of empirical rigor in the largely aspatial case studies. However, the emphasis on using simple models as a useful framework for the practice and management of ecological restoration may be a broader point that many can appreciate.

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Reference

Aronson, J., S.J. Milton and J.N. Blignaut (Eds.) 2007 *Restoring natural capital: Science, business and practice.* Island Press, Washington D.C.