



BOOK REVIEWS

Sinclair, A. R. E., K. L. Metzger, S. A. R. Mduma, and J. M. Fryxell (eds.). *SERENGETI IV: SUSTAINING BIODIVERSITY IN A COUPLED HUMAN-NATURAL SYSTEM*. University of Chicago Press, Chicago, Illinois, xii+841 pp. ISBN-13: 978-0-226-19616-9 (paper), \$65.

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Arguably, the Greater Serengeti Ecosystem is the most thoroughly studied terrestrial ecosystem on earth, owing largely to the dedication and focus of Anthony R. E. Sinclair. The year 2015 marks both the publication of this volume and the 50th anniversary of Sinclair's research program in the Serengeti, so *Serengeti IV* is an especially momentous contribution. This book is mind-boggling in its scope, synthesizing a suite of multiyear studies ranging from the abundance and diversity of arthropods within Serengeti National Park (Chapter 10 de Visser et al.) to strategies for disincentivizing poaching through the development of alternative incomes (Chapter 22 Rentsch et al.). But rather than a random assortment of loosely related studies, the chapters in this volume are unified under a common theme: human livelihoods and nature conservation are inseparable, complicating though this may be for traditional conservation efforts (Neumann 2002; Western et al. 2015).

This volume distinguishes itself from its early predecessors *Serengeti* (Sinclair and Norton-Griffiths 1979) and *Serengeti II* (Sinclair and Arcese 1995) not only in addressing this reality head-on but in acknowledging a rather inconvenient truth: that win-win solutions for traditional preservationist practices alongside sustainable agriculture and pastoralism are rare or altogether absent. As a result, it becomes necessary to articulate the trade-offs between ecological and social systems inherent to conservation efforts or to modify the mentality historically applied to protected areas. *Serengeti IV* excels in doing both. The book is organized into 6 sections, of which 3 (*III. The Human Ecosystem and Its Response to Disturbance*; *IV. Coupled Human-Natural Interactions*; and *V. Consequences of Disturbance for Policy, Management, and Conservation*) are devoted entirely to the interplay between "natural" processes within Serengeti National Park (wildebeest migration, fire return intervals, changes in tree cover, and the like) and socioeconomic processes within the human-occupied game reserves surrounding it. These 3 sections make a convincing case that Serengeti National Park—and protected areas in general—are paramount to understanding if, how, when, and where coupled human-natural systems are sustainable. This is because, for all of its appeal, the jury is still very much out as to whether community-based conservation is sustainable (e.g., Chapter 1 Sinclair and Dobson—Doak et al.

2013; Marvier and Karieva 2014; Humavindu and Stage 2015). Consequently, biodiversity dynamics within protected areas provide critical "controls" against which those in human-occupied landscapes can be compared to evaluate system resistance and resilience (see also Arcese and Sinclair 1997).

For all its utility as an ecological baseline, though, I suspect that I am not alone among mammalogists in my belief that Serengeti National Park's greatest significance lies in the sheer magnificence of its ungulate migrations, particularly in light of the increasing rarity of such migrations (Harris et al. 2009). The influence of plains zebra, Thomson's gazelle, and especially wildebeest migrations reverberates through virtually every aspect of this iconic ecosystem, a theme common to the remaining sections that contain the majority of *Serengeti IV*'s chapters.

The cascading impacts of wildebeest in Serengeti are perhaps best understood in light of the introduction and subsequent eradication of rinderpest in the late 1890s and early 1960s, respectively (Chapter 2 Sinclair et al.). This "natural pulse experiment" decimated ruminant populations, such that wildebeest rebounded from a historic low of about 200,000 individuals to roughly 1.3 million individuals in the late 1970s. This profound recovery reduced grass cover, which in turn triggered widespread tree recruitment that then sustained an increasing elephant population. Metzger et al. (Chapter 3) explore the ultimate drivers of wildebeest migration—countergradients of soil nutrients and rainfall—that buffer against the effects of drought to sustain migrations as well as a diversity of resident (nonmigratory) ungulates. Eby et al. (Chapter 4) describe the fascinating dependence of fire frequency on environmental context: where wildebeest are abundant, the frequency and magnitude of fires are reduced. Where grazing pressure from wildebeest is reduced, fire frequency and magnitude are largely driven by understory biomass, which is itself a function of precipitation. Overall, the Greater Serengeti Ecosystem has exhibited a shift from fire being ignition-limited during the rinderpest epizootic to fuel-limited following the rinderpest vaccination campaign.

In some instances, edited volumes run the risk of becoming "catch-alls" for material that has not found a home in more traditional, peer-reviewed outlets. *Serengeti IV* avoids this trap through broad, conceptual appeal to ecologists, social scientists, and natural resource managers, regardless of their geographic inclinations. Indeed, the vast majority of the 27 chapters could just as easily be published as stand-alone papers to high-tier journals in their own right, and the editors are to be commended for holding contributors to such a high bar. Three particularly strong pieces that stand out to me are Anderson et al. (Chapter 4), Fryxell et al. (Chapter 6), and Craft et al. (Chapter 15). Anderson et al. use Serengeti trees and understory plants to explore classic questions in community ecology surrounding species turnover across space and through time. Despite perceptions that

Serengeti is exceptionally diverse, the authors conclude that its understory diversity is sparse relative to other savanna grasslands. Fryxell et al. employ structural equation modeling and systems of differential equations to project predator–prey interactions in a world of increasing rainfall variability. A main conclusion is that wildebeest and potentially lion recruitment are likely to increase with increasing dry-season rainfall. Given the overriding importance of wildebeest in structuring Serengeti, their study is a compelling example of the links between global climate change and local dynamics within this famous protected area. Craft et al. analyze the habitat marginality (selection of habitats deviating from “average” selection by other species) and tolerance (the selection of restricted habitats) of carnivores. Such multifaceted quantification of habitat use versus availability holds promise to solving the age-old conundrum of why some species specialize, while others are willing and able to exploit the resource gamut.

Some of my colleagues and I regularly lament the disappearance of journals that would publish explorations of concepts, ideas, or natural history quirks. Increasingly, edited volumes are one of a very small number of outlets that encourage this kind of free-form rumination. As such, I was utterly captivated by Hopcraft et al.’s Chapter 5, entitled “Why are wildebeest the most abundant herbivore in the Serengeti ecosystem?.” Although this chapter certainly makes use of lots of high-quality data, it has a slight speculative feel by necessity, reminiscent of classic papers from the 1960s and 1970s published in *The American Naturalist*. By themselves, wildebeest outnumber all other populations of mammals combined in Serengeti, and they are 100 times more abundant than their closest co-occurring relative (hartebeest). The authors use a weight-of-evidence approach and walk the reader through an elimination process of several hypotheses. They conclude that the countergradients of soil nutrients and rainfall occur over a spatial extent that is uniquely suited to wildebeest biology, enabling this ungulate to (1) swamp predators with highly synchronous birth pulses; (2) consume and facilitate growth of matt-forming grasses over vast (> 3,500 km²) areas; and (3) migrate, thereby boosting its carrying capacity and alleviating migratory populations from top-down control.

In sum, Serengeti IV is an epic achievement. It is at once both deeply and broadly appealing, rigorous and readable, cautionary and optimistic. It belongs on the bookshelves of all ecologists (not just those working in Africa, or on large mammals, or in rangeland ecosystems), those working in human dimensions of wildlife conservation, and members of the general public fascinated by this grand ecosystem.

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Much praise has already been given in reviews of the 4 preceding volumes of *Handbook of the Mammals of the World* (HMW) for their exceptional high publication quality, the outstanding and up-to-date text, and the great number of beautiful photographs and illustrations of mammals. All of this applies to the latest exquisite offering in this 8-volume series. HMW Volume 5, covering the Monotremes and Marsupials, is an impressive, weighty tome of 799 pages lavishly illustrated with 717 color photographs, 44 color plates, and 375 distribution maps that cover the world’s five monotreme and 350 marsupial species.

The book follows the format of the previous volumes; sections reflect classification to Order and a chapter is devoted to each Family (21 in total). Each chapter is subdivided into sections on Systematics, Morphological Aspects, Habitat, General Habits, Communication, Food and Feeding, Breeding, Movement, Home Range and Social Organisation, Relationships with Humans, and Status and Conservation. Each chapter also includes one or more color plates of all extant species, followed by a detailed treatment of each species. The latter resembles the format common to field guides, with a distribution map for each species, and useful notes on its physical description, activity patterns, habitat, food and feeding, and other valuable information. However, unlike a field guide—at 31 × 24 cm, and nearly 6 kg—this “handbook” won’t conveniently fit in your pocket or daypack. So while it doesn’t replace your favorite field guide, it certainly complements it greatly.