The Biology of Deserts. Ward, David. 2008. ISBN-13: 9780199211470. ISBN-10: 0199211477. (paper US$55) pp. 339. Oxford University Press.

"The Biology of Deserts" is the (lucky) 13th volume in Oxford University Press's *Biology of Habitats* series. It is an ambitious book, in which David Ward attempts to summarize and synthesize state-of-the-art ecology of desert plants and animals, including eco-physiology and evolutionary ecology. He cites papers published in 2008, as well as many other papers from this decade, which is quite a feat. This book provides a decent orthodox introduction to the literature. The book is nicely laid out in bite-sized pieces, with usually well-delineated headings and subheadings within each chapter, although a few of the headings sound vaguely like science fiction ("Evaders and evaporators"). The writing is accessible. Ward has done extensive, excellent ecological work in the deserts of southern Africa and Israel, which will be obvious to any reader.

This volume begins with the onerous task of defining deserts. It then launches into three chapters on abiotic factors and how plants and animals may have adapted to these factors. This is followed by four chapters on biotic interactions, including competition, predation, parasitism, mutualism, and food webs. Next is a chapter on larger-scale phenomena of biodiversity and biogeography. The book ends with a pair of chapters on human influences, desertification, and conservation.

While this book usually describes things that many desert ecologists know, there are some interesting and possibly seldom known facts interspersed. We usually think of desert or other terrestrial ecosystems as closed systems, but Ward cautions us that in coastal deserts, especially west coasts of the Americas and Africa, one of the major oft--forgotten inputs to the food web are marine life, such as terrestrial invertebrates feeding on marine algae or terrestrial mammals feeding on marine mammal carcasses. Another fun example is various *Bursera spp.* that squirt terpene resins from chewed leaves, squirting these in a syringe-like-fashion up to 1.5 metres, as a deterrent to phytophagous animals. However, some beetles in the genus *Blepharida* can disable this mechanism by investing 1.5 hours cutting the resin canals, even though they can then eat the leaf in 10-20 minutes! We also learn that endolithic lichens fix atmospheric nitrogen. Snails then eat the lichens, secreted rocks and all, thereby adding useable nitrogen to the ecosystem. While not botanical, we learn that some spiders avoid being eaten by rolling down dunes at rates of up to 2650 rpm and 1.5 m/sec.

The author's discussion of desertification has some conventionally bad aspects and some refreshingly good aspects. I never understood why replacement of herbaceous plants by woody plants is bad, unless your criterion is based on utility to those who eat products of mammals. Vegetarians and especially vegans should have no problems with the transition from herbaceous to woody vegetation in deserts. Ward also claims that one of the primary reasons for increase in desert fire intensity and frequency is encroachment of woody vegetation. While this may be true in Israel or southern Africa, in the Americas, the major new ecological fire risk is fast-burning exotic annual grasses. Woody plants are not always bad for deserts and herbaceous plants good. To his credit, Ward highlights that woody vegetation is advantageous insofar as it provides a larger carbon sink than herbaceous vegetation, which is no trivial matter in an era of accumulating anthropogenic carbon dioxide accumulation.

While this book starts with the famous quote from Dobzhansky that "Nothing in biology makes sense except in the light of evolution," the only evolution discussed in this book is adaptation and selection. Other evolutionary forces are undoubtedly important, especially in deserts. Kevin Ross (2006; *Evol. Ecol. Res.*) showed that fossorial animals incur higher mutation rates due to radon build-up in their burrows, while I hypothesized that cactus evolution is much more driven by drift than selection (2009; *Bradleya*). By contrast, as an example, Ward invokes the following adaptation-centric trichotomy of seed dispersal in plants: adaptation for long-distance dispersal (telechory), adaptations to prevent dispersal (antitelechory), and lack of adaptation for dispersal (atelechory). The closest this book comes to mentioning drift or mutation is a brief mention of effective population size in the final chapter on conservation.

Ward does an exemplary job juggling both plant and animal ecology, as well as deserts at opposite ends of Africa. He is human and can only have so much breadth. So it should not be too surprising that he errs slightly with details when discussing North America. He uncritically accepts an age of over 10,000 years for some clones of creosote (*Larrea tridentata*). He uses long-outdated nomenclature for the barrel cactus *Ferocactus acanthodes*, which should be *F. cylindraceus*. Juggling both plants and animals may have also resulted in using an outdated family name for his native species of *Aloe* (Liliaceae vice Asphodelaceae). For reasons I do not comprehend, he classifies *Aloe* (African) as a leaf succulent and *Agave* (North American) as a stem succulent, despite *Aloe* having the more arborescent forms of these two woody monocots. I was also befuddled by his comparison of supposed convergent evolution of *Aloe* and *Yucca*, two closely related monocots, with convergent evolution of cacti and euphorbias, two distantly related eudicots. Despite these foibles, his broad-brush views of desert ecology seem to reflect consensus views.

One curiosity that Ward mentions several times throughout this book, always matter-of-factly, is that all desert ecosystems are nitrogen-limited, except for Australian deserts that are phosphorus-limited. This will stoke up both the 'nitrogen nuts' and 'phosphorus fanatics' in the ecological stoichiometry debate (apologies to my friends and colleagues involved in this debate). My naïve guess is that much less stoichiometric work has been in Australia and those working there simply have a predilection towards the phosphorus side of this ongoing debate. That said, I hope more people test the idea that Ward puts forward of Australia's old flat geography driving phosphorus limitation.

Unfortunately this book suffers from inconsistent editing (maybe something to do with lucky 13?). Here, I provide a short list of these problems, which appear throughout the book. Many of the data plots fail to show significance levels, e.g. standard error, correlation coefficient, p-values, overall F-statistics. One cannot therefore discern whether the purported results are valid, forcing readers to go back to the primary literature. There is no detailed table of contents, despite the nicely numbered subheadings in each chapter. And some of the subheadings are downright misleading. Subsection 4.1.1. titled "snails" actually covers snails, frogs, birds, spiders, squirrels, termites, and marsupials. Many of the photos are poorly enough reproduced to be of no use. Too many captions are careless and/or incomplete. On figure 5.20, the x-axis labels are cropped, deleting the bottom half of all subscripts. Abbreviated versions of binomials are used, even when the genus name was last used and spelled-out 30 pages earlier, e.g. *Boscia albitrunca*. This editorial deficiency severely detracts from an otherwise good, overview textbook.

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