which is in the form of the enzyme ribulose bisphosphate carboxylase/oxygenase. In other words, because of the enormous differences between plants and animals in their elemental ratios, animals live in a world where nitrogen might be vanishingly scarce even when plant mass is abundant. This scarcity of a key element underlies many of the evolutionary and ecological patterns observed in terrestrial ecosystems.

In seven brief and pleasant chapters, White outlines his evidence for the above argument and attempts, with mixed success, to use this insight to reconcile the 'weather' and 'density' camps. He argues that weather does have a role in population dynamics, but that weather affects these dynamics principally through its influence on food supply.

There are a plethora of implications and applications of White's argument. On a very local scale, his argument suggests that, because insects are cueing on nitrogen rather than biomass, plant defensive tactics should be geared toward minimizing insect access to nitrogen. Given the paramount role of nitrogen in plant growth and reproduction, it is difficult to separate the White idea from the conceptually simpler idea that plants should be protecting their most-limiting resource. These two hypotheses could be tested, however, in an ecosystem where another element (e.g. phosphorus) is known to limit plant productivity. Of course, nitrogen and phosphorus are physically linked in tissues, so it might, in practice, be difficult to distinguish defensive tactics.

On a broader scale, White's argument links together the HSS paper [1] with an even more influential one of two years earlier, Redfield's demonstration that the chemical composition of the ocean is, to a large extent, regulated by the abundance and activity of organisms in the ocean [3]. This approach, now known as ecological stoichiometry, has enabled tremendous progress in the linking of different scales of ecological research and in bringing together ecological and evolutionary theory [2,4]. *Why Does the World Stay Green?* explicitly links the regulation over the distribution and abundance of organisms at different trophic levels, the main concern of HSS [1], with their chemical compositions and elemental ratios, the thrust of Redfield [3]. One can quibble with the details, object to some of the examples, and dislike the style of argumentation, but few books in ecology tackle such important topics, raise such interesting ideas, and are so much fun to read.

References

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3 Redfield, A. (1958) The biological control of chemical factors in the environment. *Am. Sci.* 6, 205–221
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Disease and ecology: crossroads in primate evolution

Infectious Diseases in Primates: Behavior, Ecology and Evolution by Charles L. Nunn and Sonia Altizer, Oxford University Press, 2006. US$99.50/US$49.50 hbk/pbk (400 pages), ISBN: 9780198565840/9780198565857

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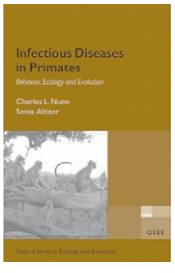

What is more significant for primate survival and behavior: a leopard stalking baboons on the African floodplain, or a pin worm crawling through the colon of a squirrel monkey? In *Infectious Diseases in Primates*, Nunn and Altizer argue that, although pathogens and parasites are more cryptic and less spectacular than fanged predators, they could in fact have a role equal to or greater than both predation and resources in affecting the distribution, behavior and abundance of primates. This is an innovative view compared with more traditional primate ecology, where resource competition and predation have been regarded as the overriding forces that influence primate social systems. Furthermore, this is a leap for disease ecology, where research has historically focused more on how host traits affect patterns of parasitism rather than on the more challenging question of how pathogens influence host traits. In addition to these stimulating evolutionary arguments, *Infectious Diseases in Primates* provides a comprehensive synthesis of the emerging and topical field of disease ecology.

The first half of the book is devoted to background material: the authors build from the level of the pathogen or parasite and how its characteristics influence disease risk at individual, population and species levels to how host immune responses, traits and ecological parameters interact to influence patterns of parasitism. Throughout, Nunn and Altizer integrate evolutionary principles with those of ecology, epidemiology, immunology and behavior, supporting their arguments with a comprehensive set of empirical and theoretical examples. As a two-authored volume, *Infectious Diseases in Primates* offers a consistency and clarity of style that makes it a very digestible read. However, as the authors present material from an inherently multidisciplinary

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field, perspectives from other disciplines, such as veterinary medicine or microbiology, would have added value in some places.

These background sections are followed by a 'synthetic' chapter that integrates the preceding material to consider the question 'do host traits and social organization influence patterns of parasitism or do parasites influence patterns of host sociality?' The authors show that these questions are not mutually exclusive; however, teasing apart the various causal factors can be intellectually challenging, if not sometimes impossible. And here lies the conundrum: in any given system, how do we differentiate the direct effects of parasites on host sociality from the effects of other ecological and evolutionary factors that, in turn, impact the spread of infectious diseases? On top of this complexity, there are coevolutionary dynamics that can obscure the effects of parasites on host social systems. For example, highly social animals are predicted to experience greater parasite pressure, but in response to this pressure they might undergo intensive selection for immune defenses that limit transmission, which can then eliminate the predicted pattern of increased transmission in highly social hosts.

After all of the build up to this synthetic chapter, it was rather disappointing to learn that there is little convincing evidence for broad effects of parasites on host social organization. However, the authors' arguments are compelling, and they clearly outline predictions and methodological approaches for further research; laying the groundwork for future progress in this field. Nunn and Altizer conclude by applying the material developed in earlier chapters to questions in primate conservation and human health.

Primates are an ideal group for investigating host–parasite interactions because so much is known about their biology. Furthermore, as highly social animals they are exposed to a variety of parasites and should be under pressure to invest resources in anti-parasite counter-strategies. Nevertheless, what happens to primates cannot necessarily be extrapolated to other taxa, but most examples in *Infectious Diseases in Primates* are actually non-primate in origin; therefore, the book should have wide appeal for anyone interested in the ecology of infectious diseases. In fact, the text could be used alongside Hudson *et al.* [1] as a general reference in disease ecology. However, the book will be of particular value to students and professional researchers with an interest in primates. The sections at the end of each chapter outlining questions for future research might be useful as a stimulus for new research, while the literature review and syntheses might inspire non-ecological disease researchers to consider more of the rich and complex linkages between ecology and disease. I thoroughly enjoyed *Infectious Diseases in Primates* and highly recommend it to those with a passion for diseases or primates.

Reference

1 Hudson, P.J. *et al.*, eds (2002) *The Ecology of Wildlife Diseases*. Oxford University Press

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