# Energetic Food Webs: An Analysis of Real and Model Ecosystems

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essay on “The persistent influence of failed scientific ideas,” which documents the many ways in which discredited genetic ideas insert themselves into the public’s consciousness—and into high school textbooks—and are difficult to dislodge.

Sometimes, statements in the book drift into overstatement. Has genetic sequencing really “not put us conceptually that far ahead of where we were at the beginning of the twentieth century” (p. 24), as Hubbard states? Probably not, but I had to think about it for a while. Is it true that “genes for psychiatric disorders and for normal variation in psychological traits do not exist” (p. 95), as Jay Joseph and Carl Ratner contend? Perhaps, but an “alternative paradigm that emphasizes the role of familial, social, cultural, and political influences” (p. 106) may swing the pendulum too far in the other direction. Still, even when trying to be provocative, the authors move the discussion forward.

*Genetic Explanations: Sense and Nonsense* is a valuable compendium of ideas that deserve far more attention than they have received. All geneticists should be familiar with these arguments, even if they disagree with some of them. After all, the naysayers so far have a better track record than do the gene jockeys.

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## A THOROUGH VIEW OF FOOD WEBS

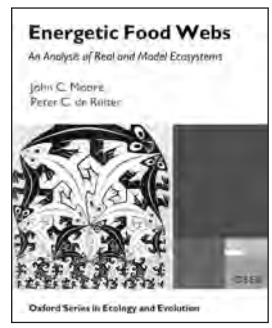
**Energetic Food Webs: An Analysis of Real and Model Ecosystems.** John C. Moore and Peter C. de Ruiter. Oxford University Press, 2012. 344 pp., illus. $59.99 (ISBN 9780198566199 paper).

*Energetic Food Webs: An Analysis of Real and Model Ecosystems* is a new title in the Oxford Series in Ecology and Evolution, which is edited by Paul H. Harvey, Robert M. May, H. Charles J. Godfray, and Jennifer A. Dunne. In today’s world of academic sound bites, in which journal articles have become shorter and shorter, often containing the smallest publishable unit of science, I am happy to see in this and in similar series that a significant number of ecologists still find the time to write monographs that thoroughly outline and develop an important topic.

Coauthors John C. Moore and Peter C. de Ruiter have a long history of joint publications, their first (to my knowledge) dating back to 1990 and also focused on food webs (Moore et al. 1990). Moore is a professor and head of the Department of Ecosystem Science and Sustainability and director of the Natural Resource Ecology Laboratory at Colorado State University. He has received many honors, including the Eugene P. Odum Award for Excellence in Ecological Education in 2011 from the Ecological Society of America. De Ruiter is professor of theoretical ecology at Wageningen University, in the Netherlands. Together with Volkmar Wolters, de Ruiter and Moore previously edited another book on food webs (de Ruiter et al. 2005).

*Energetic Food Webs* targets both graduate-level students and professional researchers and strives to “advocate an integrative approach” to the study of food webs, which uses aspects of both “an individualistic community-based approach and a holistic ecosystem-based approach” (pp. 3–5). The authors have organized the book into three sections: The first section is a treatment of simple and multispecies community modeling, the second section addresses the stability of simple and complex communities, and the third section develops the dynamic architecture of food webs.

The first section begins with simple connectedness food webs (representing a community-based perspective), in which the feeding relationships between organisms are depicted and an example is made of a soil food web of the North American shortgrass prairie. Moore and de Ruiter then extend the connectedness food web to an energy flux web (representing an ecosystem-based perspective), in which the transfer of energy or matter from resources to consumers is depicted. Finally, their integrative approach is extended to functional webs, in which the strength of interactions among species is depicted, thus merging the community- and ecosystem-based perspectives. The authors use several empirical food webs to illustrate their models, and this combination of theory and example is very useful.




After describing the different kinds of food webs, Moore and de Ruiter explore the stability of food webs in the second section of the book and, in particular, how stability is affected by energy flux (e.g., responses to enrichment and disturbances). They investigate whether the architecture of food webs is compartmentalized, thereby identifying “energy channels as energy-based compartments within food webs that describe the flow of matter and energy through food webs” (p. 125) and how such compartments affect the stability of food webs.

Whereas Moore and de Ruiter assume a static architecture of food webs in the first two sections, they introduce food webs changing over time in the third. The authors also link this dynamic perspective of food webs to classic concepts and theories in ecology, specifically to the keystone species concept, which “was introduced as a metaphor to signify the importance of species that are low in number or biomass yet exert a high

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degree of control over the structure and stability of a food web" (p. 236; also see Paine 1966), and to the theory of island biogeography championed by MacArthur and Wilson (1967). I also enjoyed the interesting discussion about the different definitions of *stability* from the dynamic perspective in this section.

In reading *Energetic Food Webs*, I found the number of typos a bit annoying. I also found some mistakes in the treatment of consumer functional responses and was surprised that some key references were missing. A concluding chapter boasting a broad perspective, similar to that of the book's opening chapter, would have helped tie the loose ends together. In addition, for some readers, getting lost in technical details is a danger throughout the bulk of the book. Putting some of this detail into an appendix would have improved the book's readability. A final drawback to this volume is that even the paperback version is expensive, despite having no color illustration. However, postgraduate students and researchers interested in food webs should be happy to see the publication of this book, as I am, because there are not many such thorough treatments of this topic available.

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## CAUSES AND CONSEQUENCES OF CHARACTER DISPLACEMENT

**Evolution's Wedge: Competition and the Origins of Diversity.** David W. Pfennig and Karin S. Pfennig. University of California Press, 2012. 320 pp., illus. $75.00 (ISBN 9780520274181 cloth).

The astonishing variety of life on Earth continues to inspire biologists in their search for explanations of the origins and maintenance of diversity. In *Evolution's Wedge: Competition and the Origins of Diversity*, authors David and Karin Pfennig (both at the University of North Carolina, Chapel Hill) synthesize and speculate on one such explanation: Competition among species is the dominant driving force in the divergence of lineages over evolutionary time, and this process of character displacement is ultimately responsible for many of the major features of biodiversity.

Competition was, of course, central to Darwin's (2009 [1859]) theory of evolution by natural selection. His well-known metaphor is an inspiration for this book's title: "The face of Nature may be compared to a yielding surface, with ten thousand sharp wedges packed close together and driven inwards with incessant blows, sometimes one wedge being struck, and then another with greater force" (p. 67). Despite this idea's long heritage, our understanding of how competition drives evolutionary diversification remains limited. It is this void that *Evolution's Wedge* aims to fill.

Synthesizing such a diverse theme within a single book is an ambitious task, but the authors are well placed to tackle it. Through a series of careful observations and experiments over the last decade, the Pfennigs have revealed, in unusual detail, the complex unfolding of character displacement between two species of spadefoot toads, *Spea multiplicata* and *Spea bombifrons*, in the southwestern United States (Pfennig and Murphy 2003). This research provides one of the best-documented cases of character displacement in the wild, thus making the authors leading authorities on how biotic interactions shape evolution. Their natural-history perspective is reflected throughout the book through the use of detailed case studies to illustrate key concepts and arguments.

Since Brown and Wilson (1956) coined the term, *character displacement* has often become synonymous with a geographical pattern in which ecological or reproductive traits differ to a greater extent where species co-occur (*sympatry*) than where they do not (*allopatry*). However, the Pfennigs stress that *character displacement* is not simply a pattern but a process, defined as "trait evolution that arises as an adaptive response to resource competition or deleterious reproductive interactions between species" (p. 24). Moreover, they argue for a broader view of the term than is typically appreciated—one that includes not only trait divergence and convergence but also specialization and *escalation* (increased competitive ability). The decision to lump these different evolutionary trajectories under one label could generate some semantic debate. I found this more-inclusive definition to be enlightening, however; it should encourage a more holistic view of the role of competition in evolution.

*Evolution's Wedge* begins with an outline of the approaches used to study character displacement and the criteria required to demonstrate its occurrence. A more formal review of the evidence might have strengthened the book, although this kind of overview has admittedly been done elsewhere (Schluter 2000, Stuart and Losos 2013). Instead, the authors work from the knowledge that because character displacement has been demonstrated, what is now needed is an in-depth treatment of its causes and possible consequences. The book is divided into two broad sections that reflect these major goals.

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