Species Interactions in Ecology

Community Ecology. JARED DIAMOND and TED J. CASE, Eds. Harper and Row, New York, 1985. xxii, 665 pp., illus. $37.50.

Over the past 10 years or so, there has been an increasing awareness among community ecologists that the dynamical behavior of assemblies of plants and animals is likely to be highly dependent on the environmental and biological setting, and even on historical accidents. In MacArthur's words (quoted by R. K. Colwell in *A New Ecology*, P. W. Price *et al.*, Eds., Wiley, 1984), "The future principles [will] be of the form 'for organisms of type A, in environments of structure B, such and such relations will hold.' " Noting that "there has been a biological tradition of searching for the best organism to solve a problem," MacArthur advised that "ecologists should resist this temptation" because the answers to the problems are likely to be different for different groups of organisms. The present book (the outcome of a meeting held in California in 1984) joins other recent conference volumes (two such books—*A New Ecology* and *Ecological Communities*, D. R. Strong *et al.*, Eds., Princeton University Press, 1984—were reviewed in *Science* **228**, 871 [1985] by T. R. E. Southwood; a third is *Evolutionary Ecology*, B. Shorrocks, Ed., Blackwell Scientific, 1985) that focus on the ineluctably contingent nature of such rules and patterns as are to be found governing the organization of communities.

The volume appropriately opens with an essay by Diamond on the relative strengths and weaknesses of different approaches to understanding how communities work: laboratory experiments, field experiments, and natural experiments. Natural experiments can further be subdivided into "snapshots," in which one observes the final state of an established system, and "trajectories," in which one observes or reconstructs the course of events (possibly following a perturbation such as an epidemic or a volcanic eruption). Diamond makes a persuasive case that in ecology—as in geology or astrophysics—these approaches all have important roles to play, depending on the situation. Diamond goes beyond listing the intrinsic advantages and limitations of each approach to suggest possible improvements; much could have been learned from analytic studies of the community-level consequences of such "natural experiments" as the introduction of myxomatosis into rabbit populations in Australia and England or the removal of most of the large whales from the Southern Ocean. Some of Diamond's ideas are illustrated in the next two chapters, one dealing with a laboratory community of *Drosophila* (Gilpin *et al.*) and the other with field experiments on a community of desert granivores (Brown *et al.*).

The remaining 30 chapters are grouped under six headings: Species Introductions and Extinctions, Space and Time, Equilibrium and Nonequilibrium Communities, Forces Structuring Communities, Kinds of Communities. Each section begins with a chapter of synoptic overview, which is followed by chapters devoted to studies of a particular community or to reviews of collections of such studies. The degree of synthesis provided by these overview chapters elevates the book above the general run of conference proceedings.

The addition or removal of species, particularly on islands, by the accidental or deliberate acts of humans can offer insights. In their overview of the section Species Introductions and Extinctions, Diamond and Case survey a range of examples and sketch a tentative codification of the things that can happen. Moulton and Pimm give an illuminating account of the ways in which introduced bird species have perturbed the native Hawaiian avifauna, creating a new and synthetic lowland avifauna within the past 125 years.

The section Space and Time includes papers by Wiens (surveying the way the choice of spatial scale affects conclusions about habitat patterns in shrubsteppe birds), Grant (showing that climate fluctuations in the Galapagos mean that seed-eating finches are likely to experience interspecific competition for food at least once in each generation), and Kareiva (summarizing field experiments on the way patchiness and dispersal influence the dynamics of herbivorous insects and their predators).

In the section Equilibrium and Nonequilibrium Communities, Strong argues that density-dependent regulation of natural populations may be important at high and possibly at low densities, but that most of the time the dynamics of many populations (especially of insects) is little affected by density and is thus "density vague." That is, density-dependent effects may set the range over which populations fluctuate, but within that range most changes may be independent of population density. In their comprehensive and lucid discussion of the roles of chance, variability, and history, Chesson and Case go beyond this to emphasize that "if one wishes to explain a population's mean density, when sampled over time, a study of density-dependence at the population extremes will be necessary. Indeed, density-dependence and density-independent fluctuations will interact to produce this mean density, as commonly observed in stochastic population models."

I especially enjoyed the chapters by Davis, Van Devender, and Graham on fossil evidence about past ecosystems. Davis emphasizes that climate exhibits systematic changes on any time scale from a decade to 10^5 years and then shows that plant species differ in their ability to track environmental change. Many communities track climate changes too slowly to be able to remain in equilibrium with the prevailing environment. Davis also observes that "differences in the relative abundance of species in the deciduous forest communities of Europe during successive interglacials suggest that the same constellation of species formed alternative communities." The plant and animal remains found in pack-rat middens by Van Devender and the abundant fossil remains of North American small mammals studied by Graham provide a record of past community trends. Contrary to any view of an orderly procession of communities, lockstepped with climate zones, south and then north again, these authors find "different species moved in opposite directions; communities were massively reshuffled; most late Pleistocene communities had more, not fewer, small mammal species than do modern communities." These chapters, and the earlier chapter by Knoll comparing 391 fossil floras over the past 400 million years, show that paleoecology has much to teach us about the present.

The section Forces Structuring Communities is more evenhanded in its discussion of relations among species than is the case elsewhere in the book, where the emphasis is mainly on competition or on predator-prey interactions. Addicott discusses mutualism, with emphasis on the population-level consequences of mutualistic interactions (as distinct from the fascination with natural history that characterizes most discussions of mutualism). Colwell's account of the dispersal of hummingbird flower mites in the bills of hummingbirds and Wilson's account of the mites that are dispersed by carrion-feeding beetles both draw larger morals about the way species can interact indirectly, via mediating species. Toft discusses the dynamics of host-parasite associations (with parasites including viruses, bacteria, protozoans, helminths, and arthropods) and the role they can play in structuring communities; this chapter combines review and synthesis of recent material with some fresh perspectives and ideas.

Introducing the final section, Schoener makes a heroic attempt to classify the kinds of communities found in nature, using six axes relating to properties of the organisms, six relating to properties of the environment, and 10 derived from community properties. Although sometimes reminiscent of a Victorian Scots Presbyterian sermon ("and thirteenthly, bretheren"), this is an interesting attack on a central problem. Other chapters in this section focus on particular communities: among others, Roughgarden contrasts *Anolis* with barnacle communities, Buss looks at competition on hard surfaces in the sea, and Lubchenco evaluates competition versus predation in seaweed communities in New England.

The references are all collected at the end. Running to 62 pages, they constitute a valuable resource in themselves.

Overall, this book takes a very narrow view of what "community ecology" is but has the compensating advantage of pursuing that view in great depth. Community ecology here is, in effect, taken mainly to mean interactions among species. There is no account of patterns of energy flow or nutrient flow, and very little attention is given to biomass or food web patterns as such. Decomposers suffer their usual neglect, being mentioned only once (and that in passing) in Tilman's discussion of competition for resources in plant communities. Even within this concentration on countable individuals and species—as distinct from the less intuitively evident biomass or energy flow—the emphasis is more on interactions within and between species than on such things as the relative abundance of species or the length of food chains. Species relative abundance does receive interesting discussions in the chapters by Davis and by Hubbell and Foster (in their account of chance and history in the structure of tropical rainforest tree communities), and Toft discusses the interplay between food web structure and host-parasite interactions, but these are exceptions.

I think this emphasis on species interactions reflects the interests of the contributors to the book, rather than any general trend in ecological thinking. Within its domain of concentration, however, the book offers an excellent balance of new work and thoughtful synthesis. This is helped by the outstanding job of editing done by Diamond and Case, which results in the 586 pages of text by 35 authors (all but one North American) having a coherence and readability that is rare even in single-authored books.

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Memory Development

Cognitive Learning and Memory in Children. Progress in Cognitive Development Research. MICHAEL PRESSLEY and CHARLES J. BRAINERD, Eds. Springer-Verlag, New York, 1985. xiv, 250 pp. $33. Springer Series in Cognitive Development.

Basic Processes in Memory Development. Progress in Cognitive Development Research. CHARLES J. BRAINERD and MICHAEL PRESSLEY, Eds. Springer-Verlag, New York, 1985. xvi, 324 pp. $39. Springer Series in Cognitive Development.

Prior to the publication of these two volumes, it seemed that the field of memory development, which began in earnest in the late '60's and flourished during the '70's, was declining rapidly and would be largely nonexistent in 10 years. These volumes make clear that, if the field survives, future research will be characterized by a more expansive and integrative style than was recent work and by more frequent forays into subjects once considered distinct from memory development (for example, metaphor comprehension, fantasy, and spatial maps). Future work on the subject will attempt to make connections with other aspects of cognitive development as well as with historical and philosophical traditions that went unrecognized during the heyday of the '70's.

The volumes are a compilation of 14 chapters edited by two respected researchers neither of whom, it seems fair to say, has been associated with attempts to step outside of traditional memory development research in the past. At a time when the field's strength is also its weakness—that is, when increasingly fine-grained analyses of basic memory processes have reduced the scope of problems to the point where newer researchers often fail to see the importance of the problems being investigated—the editors have assembled a cast of authors all of whom display, to some degree, the sort of expansiveness in thinking mentioned above.

In an undertaking of this scale, one can point to faults: it is not clear why the volumes are titled as they are or why certain chapters appear in one volume rather than the other, two chapters are largely duplicative of their authors' comments elsewhere, the chapters are of uneven quality, though few are truly weak, and one can question why other subjects were not included.

The chapters are united by little more than their individual efforts to integrate and synthesize broad domains of cognitive developmental research. Chapters by Ackerman, Dempster, Bjorklund, and Brainerd deal with basic processes that underlie memory development; those by Anooshian and Siegel and by Reyna are concerned with the role of memory in other types of cognition, such as spatial reasoning, fantasy, and metaphor comprehension; and those by Paris, Newman and Jacobs, and Rogoff and Mistry address important cross-cultural and philosophical issues that have habitually been ignored in past treatments of this type, despite their obvious significance. Finally, chapters by Pressley *et al.* and Marx, Winne, and Walsh deal with the educational relevance of strategy training and school learning, and those by Kail, Salthouse and Kausler, Daehler and Greco, and Levin deal with methodological and statistical problems inherent in studying learning and development.

The evidence presented in several chapters suggests that memory processes cannot be adequately studied in the disembedded laboratory contexts that have characterized the majority of work on the subject. Contexts vary in the effectiveness with which they recruit mnemonic strategies, foster motivation, and shape one's perception of the particular memory task at hand. One of the many important messages of these volumes is that the exclusive reliance upon laboratory contexts is likely to result in misleading models of memory development.

The expansive vision of the future of memory development research presented in these volumes should serve as a tonic to the spirits of researchers who have been concerned about whether their work was relevant.

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The Australian Phanerozoic

Phanerozoic Earth History of Australia. J. J. VEEVERS, Ed. Clarendon (Oxford University Press), New York, 1984. xvi, 418 pp., illus. $75. Oxford Geological Sciences Series, 2.

This book is intended as a modernization of earlier books on the tectonic history of the Australian region. The authors assume that Australia's evolution since the late Precambrian can be described in terms of the same plate tectonic processes that are shaping the earth's surface today. In effect, a conceptual filter has been applied to a vast body of field data, a point that readers should bear in mind. That does not detract from the book's value in my opinion, since there are almost 51 pages of references that give readers skeptical of given interpreta-