Book Reviews

Concepts of Ecosystem Ecology

Edited by L.R. Pomeroy and J.J. Alberts
Springer-Verlag, New York 1988
384 pp.
Price: DM128

This 67th volume in the 'Ecological Studies' series arises from a conference honouring Professor Eugene P. Odum, on the occasion of his retirement, although neither the date nor venue of the conference are specified.

Authorship is exclusively North American, with 18 USA and one Canadian contributor to the 16 chapters which comprise the volume. In their preface, the editors indicate that instead of marking Odum's retirement with 'the usual Festschrift of otherwise unpublishable offerings from former students ... we assembled leading experts in the functional analysis of ecosystems and some related topics to consider two questions:
(i) What is the proper study of ecology, and are we doing it?
(ii) What have we learned about ecosystem function?'

Were these objectives achieved, and indeed could they be achieved within the totally American bias of the volume? Before attempting to answer the editors' questions, let me give some indication of the structure and content of the volume.

The 16 chapters consist of a mix of specific reviews dealing with specific ecosystems, and broader overviews of wider relevance to this science. The volume begins with a short chapter on 'The ecosystem perspective' in which the editors collaborate with E.C. Hargrove to set the scene for the subsequent account. This chapter explores the ecosystem concept, two fundamental ecosystem attributes (homeostasis and emergent properties), and scientific method in ecology. The artificial dichotomy which exists in practice between aquatic and terrestrial ecosystem science is condemned, and if the volume achieves nothing more than some redress of this situation in the future, it will have served an important function.

P.H. Rich, in Chapter 2, (The origin of ecosystems by means of subjective selection) deals with the important philosophical (and practical) matter of origin and causation in ecosystems: are the material and energy exchanges described by ecologists as trophic dynamics driven by, or do they drive, local entropy reversions? Chapter 3 by R.G. Wiegert (The past, present, and future of ecological energetics), sketches the historical development, and provides a general overview of issues involved in ecological energetics. Despite some experience in this important field, I did not find this an easy chapter, and it may prove obscure for the uninitiated. J.E. Schindler's 'Freshwater ecosystems: a perspective' (Chapter 4) is very cogent and articulate, and embraces an array of issues which are centrally important to this science: particularly the interface of habitat dynamics and biological dynamics, and their integration. These are succinctly addressed with reference to succession and its control in plankton communities, in a well-structured and perceptive contribution.

Terrestrial ecosystems are dealt with in the next four chapters, which collectively comprise roughly a third of the volume. W.A. Reiners considers 'Achievements and challenges in forest energetics', while 'Abiotic controls on primary productivity and nutrient cycles in North American grasslands' by P.G. Risser precedes J.K. Detling's consideration of 'Grasslands and savannas: regulation of energy flow and nutrient cycling by herbivores'. 'Agroecosystem processes' by D.C. Coleman & P.F. Hendrix completes the specific coverage of terrestrial ecosystems. Collectively, these chapters provide a very useful insight into the problems and issues facing ecosystem science on *terra firma*, and were very informative from my primarily aquatic perspective. (Yes. I'm also guilty of this artificial dichotomy). From an African context, however, I was greatly surprised by Risser's apparently total neglect of fire as an abiotic factor in grassland ecosystems.

The book then returns to water for Chapters 9 to 12. An erudite and masterful exposition of 'Ocean basin ecosystems' is provided by R.T. Barber. Defined as a unit of characteristic trophic structure and material cycles, six separate oceanic ecosystems can be recognized (upwelling coastal areas, low latitude gyres, etc). In considering El Nino and the Southern Oscillation (ENSO) cycle, Barber leads us to a radically different viewpoint, that of a wider (perhaps single) ocean basin ecosystem, the emergent properties of which are exposed by consideration of the ENSO cycle. This essay is perceptive, and scientifically stimulating, and reveals the coupling of ecosystem ecology and economy, or the *logos* and *nomos* previously discussed by Coleman & Hendrix in the context of agroecosystems. 'Coral reef energetics' by W.J. Wiebe follows 'The cycling of essential elements in coral reefs' by C.F. D'Elia. Both authors provide good overviews of contemporary knowledge concerning structure, and more especially function, of coral reef ecosystems. And both reflect on the paucity of adequate seasonal investigations of coral reefs, let alone long-term studies, as well as on the shortage of comparative studies, which they perceive as important constraints to an adequate analysis and better understanding of these systems. There is indeed an underlying irony in this situation, given that the pioneering ecosystem studies of the Odum brothers were undertaken on Enewetak coral reef in 1954. Chapter 12, 'The study of stream ecosystems: a functional view' by K.W. Cummins, one of the initial proponents of the much lauded or hotly debated River Continuum Concept, brings the reader to the 'cutting edge' of ecosystem science in the context of these 'open' systems.

We return to more general topics in Chapters 13 (Energy flow and trophic structure by S.L. Pimm) and 14 (Scale, synthesis, and ecosystem dynamics by H.H. Shugart & D.L. Urban). Despite the contentions about the validity of trophic levels, Pimm argues for their utility in comparing ecosystems, and considers why ceilings on trophic levels are so low. Simple energetic constraints cannot adequately explain these limits. Rather, Pimm explores, and presents a reasoned case for their limitation by the severity (violence) of disturbance, and the recovery response times of affected

biota. Shugart & Urban explore the need to incorporate more and better mechanisms in ecosystem models, and consider heirarchy theory more directly than other authors. Along with the authors of preceding chapters, they draw attention to the importance and significance of scale in ecosystem science, and suggest that greater attention be paid to linkages and interactions between small and larger scales: scaling down from ecosystem to individual organisms, and up from ecosystems to global biogeochemical cycles, for instance.

Drawing on a comparatively rich array of examples, K.H. Mann's chapter (Towards predictive models for coastal marine ecosystems) begins specifically to address some of the questions posed by the editors at the outset. Mann brings a clear sense of balance, proportion, and perspective to the science of ecosystem ecology, and indeed, readers initiated in ecosystem ecology could profitably commence the volume with this chapter. Recognizing the understandably negative perceptions of ecosystem science by population ecologists (particularly exemplified in fisheries management), arising from the elusiveness of general ecosystem principles, Mann argues that since ecosystems obviously exist, they require study, despite the inherent limitations of both reductionist and holist approaches. And in a very structured and logical way, Mann takes his reader down this path of inquiry. To my mind, this chapter provides the most penetrating insight, and promise for the assured future of ecosystem science. Mann explores evidence, emerging from various marine ecosystem studies, that ecosystems possess self-organization capabilities. Two or more stable states may exist, but the bifurcations which lead to one or other of these states may be selected by inherent self-organizing properties, rather than by external imposition. Oscillations between kelp-dominated and urchin-dominated systems in Nova Scotian waters exemplify this condition. This prospect is understandably very exciting, although its implications to ecosystem 'predictability' are not explored.

In the final chapter 'Problems and challenges in ecosystem analysis', the editors (Pomeroy & Alberts) effectively encapsulate the explicit or implicit common threads of preceding chapters — stoichiometry, trophic levels, trophic efficiency, stability and diversity, ecosystems as units of study, and the time warp, and provide a useful summary. The volume closes with an extensive common reference list of nearly 1100 citations for the entire volume, and a rather brief index.

Well! Returning to the editors' questions: — What is the proper study of ecology? Single word answers are clearly unacceptable here. But read this volume, and you will begin to get an inkling. Are we doing it? None of the contributors explicitly answers this rider question, but the evidence as a whole at least suggests that they're on an appropriate track. What have we learned about ecosystem function? Obviously a great deal since Tansley's time and the Odum's studies of Enewetak, although equally obviously, a long road lies ahead. However, this volume shows us that this road is at least signposted. But again, I'd urge you to get into the volume yourself to read and decipher the signpost.

From the above it should be obvious that the book has a great deal to recommend it. I certainly will have no hesitation in using parts of it for extra readings in my senior undergraduate course on 'Ecosystem Analysis', while for postgraduates in ecology, regardless of whether their interests lie at the population, community, or ecosystem level, the book has much to offer. Most misprints I encountered pose little more than an unfortunate nuisance value, and did not impair intelligibility. It is perhaps not difficult to imagine how ug (for ungrazed) becomes, μg (for microgram) (Figure 7.9), and *kn* becomes kn (Table 8.9). Some figures deserve more informative legends and/or better labelling (e.g. Figure 10.3), or less obtuse labelling (what on earth is a gramme of defense — Figure 5.11?). Nonetheless, on the whole, the book is well produced.

Ironically the volume makes no mention of the characterization of ecosystems as Middle Number Systems, the very feature which so bedevils and complicates their analysis. Perhaps more surprising was the absence of any palaeoanalysis, bearing on the issue of succession, another attribute commonly perceived to be relevant to ecosystem science. And given Odum's important application of systems analysis to ecosystems, little formal treatment of this subject appears in the book. This apparent deficiency must be seen in relation to the volume title, however. It is not a text on ecosystem analysis, but on *concepts* of ecosystem ecology, a title that will doubtless deeply disturb F.H. Rigler in his grave.

The absence of many very prominent ecosystem scientists (and the total absence of non-American subjects) from the list of contributors to the volume is unfortunate, although obvious logistical constraints exist in this regard. Given its objective as a tribute to E.P. Odum, the volume could have included a brief biographic profile of this founder of contemporary ecosystem ecology, and, notwithstanding his prolific nature, perhaps a listing of his works published to the date of his official retirement.

In summary, this is a very valuable volume, which I would urge all ecologists to consult.

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Ecophysiology of the Camelidae and Desert Ruminants

R.T. Wilson
Springer-Verlag 1989
Price: DM98,00

This book is one in a series entitled 'Adaptations of Desert Organisms' the general editor of which is J.L. Cloudsley-Thompson.

This book is a timely reminder of the deficiencies in our knowledge of animal biology. Zoological mammalian physiology, as opposed to laboratory animal and domesticated animal physiology, is virtually untouched. Wilson's book makes it clear, however, that zoological physiology will become increasingly important. Already there is recognition

that the vast areas of marginal agricultural land destroyed by overgrazing can be rehabilitated only by the reintroduction of native species. Moreover, the limits of adaptation of domesticated animals to hostile environments is increasingly realized. These ideas suggest that use of indigenous species is a more logical way to produce the raw materials of life, from arid and semi-arid zones. If we are to achieve this aim we will need to know far more than we do about the physiology of wild animals.

Furthermore, our experience shows that accumulation of knowledge about the physiology of species adapted to arid and semi-arid zones is likely to have implications for, and application to, other animals which live in less harsh environments. For all these reasons, therefore, this book is important, and more so because it reminds us just how far South Africa lags behind the rest of Africa in research into zoological physiology. Indeed only Gideon Louw and John Skinner seem to have perceived the value of such research.

While this book is important it is not a good book. Although it clearly defines the nature of an arid zone, and, rightly, concentrates on the thermoregulatory, water homeostatic and dietary mechanisms necessary for survival, it is often disjointed and tends to be 'listy'. By this I mean that too often the facts are presented as accumulated data tables and often little attempt is made to explain their significance. Some aspects of physiology, particularly endocrinology and respiration, suffer by this lack of explanation to the extent that the endocrine and respiratory physiology is simply wrong.

On the other hand the book contains in 100 pages the summarized knowledge of 70 years of research by authors ranging from Theodore Roosevelt (1914) to Louw and Maloij. As a primer of desert ecophysiology it is outstanding. For the serious student it is perhaps disappointing. As a source of ideas for further research it is excellent and deserves a place in the bookshelves of zoologists and physiologists. I enjoyed it.

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