

## Book Reviews

### **Environmental and biodiversity futures: can we predict the uncertainties?**

Chapin, F.S. III, Sala, O.E. and Huber-Sannwald, E. (Editors) 2001. *Global biodiversity in a changing environment. Scenarios for the 21<sup>st</sup> century*. Ecological Studies 152. Springer, New York. xii + 376 pp. Cloth, ISBN: 0-387-952-49-7, Euro 149.00.

Faced with increasing evidence that *Homo sapiens* has been singularly unsuccessful in maintaining habitats that provide sustainably for the future, we now see an increasing number of publications that are analysing the present with a view to changing the future. It might be easy to dismiss this book as just another such publication, but Chapin and his colleagues present a scholarly and timely account of present problems and future possibilities from a less explored perspective, that of biological diversity and world biomes. In the editors' words, "the purpose of the book is to develop future scenarios of biodiversity for the twenty-first century in 10 terrestrial biomes and in freshwater ecosystems based on global scenarios of changes of the environment and the understanding by ecological experts of the sensitivity of biomes to these global changes."

Basing the book around the detailed analyses of ten biomes is a very useful and practical approach that enables researchers worldwide to relate to issues and problems in their particular part of the world. It also links areas that are geographically separated, yet ecologically similar. As the editors point out, fundamental questions on the relationship between humans and biodiversity that have been generated by the Global Biodiversity Assessment (Heywood and Watson, 1995) and subsequently reinforced by discussions under the Convention on Biological Diversity remain largely unanswered. Yet consideration of such questions as, "How do human-induced changes in biodiversity (and the species and ecosystem responses to these changes) affect societal goods and services provided by biodiversity?" are fundamental to the future sustainability of biodiversity at all levels from gene to biome.

The chapters exhaustively draw on published information and the many references cited are a testimony to the rapidly growing field of biodiversity research. Yet, much of this research is highly reductionist and does not incorporate 'the bigger view'. This is what the contributing authors set out to provide for each of the biomes selected. However, on reading

any of the chapters it becomes obvious there are colossal lacunae in our knowledge of human effects on biomes. Nor do we know what to do about future changes. Perhaps one of the most profound messages is that despite an impressive investment in research globally, for many biological systems we seem no better prepared for the future than we were decades ago. As pointed out in the concluding chapter, biodiversity is quite sensitive to drivers of global change, and land-use change appears overall as the driver that will have the largest global effect on biodiversity by the year 2100; however, the importance of the different drivers varies enormously among biomes. Land-use change is, nevertheless, extremely difficult to predict and even more difficult to quantify, as it involves many more parameters than biodiversity, climate and abiotic environments; it involves human perceptions, ethics, trade, wealth distribution, and technology changes, each with its own array of uncertainties.

The book was based on a workshop held in the United States, and this is reflected in a considerable bias towards the New World, and especially a North American treatment of the issues (26 out of 36 contributors are from North or South America). There is also a considerable bias in the treatment of biomes, with a relative paucity of studies and references cited from outside this region and Europe. As examples, Chapter 5 (Scenarios of biodiversity changes in arctic and alpine tundra) includes no references to New Zealand and Australian studies that include at least one symposium on climate change, and Chapter 10 (Deserts) makes scarcely any reference to the desert regions of southwest Asia although this region includes some of the world's major arid lands that are continuing to undergo profound change. A surprising omission is lack of discussion of southern polar (Antarctic) ecosystems. These ecosystems may well be powerful drivers of climate change in the future and they include key species, especially among birds.

There are some notable gaps in the book that limit its utility. In terms of biomes it would have been useful to include a chapter specifically on oceanic islands; these are difficult to model in terms of conventional 'continental' biomes. They also have ecological characteristics and sensitivities that are exclusive to the oceanic environment. Although the focus of the volume is on terrestrial biomes, this is not obvious from the title, and the lack of any specific treatment of coastal and inshore systems (especially coral and bryozoan reefs) seems a major omission. The initial

four chapters are very useful general reviews of modeling and global-change scenarios generally, and soil biodiversity, but these could have been supplemented by a further chapter on social and economic drivers and how they interact with and affect biodiversity.

The volume ends with a review chapter on "Potential biodiversity change: global patterns and biome comparisons" which is a useful and succinct knitting together of the earlier chapters. This chapter reiterates that the purpose of the exercise is to develop biodiversity scenarios for the year 2100. Despite sophisticated modeling to arrive at some answers, one is left with the feeling that the range of uncertainties and the concentration on particular regions may have introduced uncertainties that cannot be balanced by modeling. For instance, the conclusion that land use will be the overwhelming driver for southern temperate systems, with a relatively unimportant contribution from biotic exchange (including invasive species), might generate interesting debates in southern Africa and New Zealand. As part of this final chapter I would have like to have seen the framework for a research agenda, tabulated in the way used in some other volumes in this series. Despite these criticisms, this volume is an invaluable source of information on biome function and dynamics. It makes a significant and important contribution to the vexing question of "What next for biodiversity?".

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### Equilibrium disturbed

Reice, S.R. 2001. *The silver lining: the benefits of natural disasters*. Princeton University Press, Princeton, New Jersey. xi + 218 pp. Cloth, ISBN 0-691-05902-0, US\$24.95.

Seth Reice is well known to stream ecologists for his research on benthic communities, and for his forthright opinions that often challenge the status quo. In *The Silver Lining* he voices his ideas on "the benefits of natural disasters", views that deserve to be heard. His major theme is that disturbances, however large, are both natural and necessary for the efficient functioning of ecosystems, and for creating and maintaining biodiversity. Reice draws his inspiration from numerous sources, including Joseph Connell (the intermediate disturbance hypothesis) and Mike Huston (the dynamic equilibrium model), but also his own

research and observations.

Chapter 1 includes a succinct and clearly written account of the differences between equilibrium and non-equilibrium concepts of community structure. Reice identifies himself clearly with the latter, perhaps not surprisingly given his experience of changeable, and physically demanding stream environments. This chapter and the next, in which he discusses the nature of disturbance, patchiness, spatial heterogeneity and their interrelationships, give the book a sound, scientific base. The bulk of the subsequent chapters present a series of case studies and personal experiences of environmental disturbances, large and small. They have been chosen well to illustrate the theme of the book, and at least some of them are likely to be familiar to most readers. In particular, Reice deals with floods and fire, but also hurricanes, eruptions, coastal pollution and the draining of wetlands. He also offers thoughts on how to live with disturbances in an increasingly human-modified world.

The Yellowstone fires of 1988 play a prominent role in supporting his central tenet that even so-called disasters are a "good thing" and that they have a silver lining, rejuvenating ecosystems and enhancing biodiversity. He discusses the dilemma faced by the U.S. Park Service with respect to their fire policy and the multiple functions of the Park. The Mississippi floods of 1993 also take central stage in an authoritative chapter on why rivers flood, the importance of floods to river communities, and the debilitating effects of dams. Less convincing to my mind is his discussion of biodiversity, ecosystem services, and human needs. We are told repetitively that disturbance promotes diversity, but whether disturbance also provides conditions that will promote diversity in genetic or evolutionary terms is not addressed. If "the nature of nature is change", and disturbance is the rule not the exception, then ecosystem functions and the services they provide (e.g. food, fibre, clean air and clean water) must also be highly variable. What implications does such variability have for conservation and management, and what levels of human-induced disturbance are acceptable? These are not easy questions to answer, and even if Reice hasn't got the answers to them, at least he got me thinking along those lines.

*The Silver Lining* is written clearly, in an enthusiastic, conversational style. It is short and attractively produced, with well-chosen and often amusing quotations at the beginning of each chapter. The spectacular dust cover depicting a forest fire literally glows in the light, but sadly, the black and white photographs of habitats rarely do justice to their subjects. Although controversial, Reice's message that disturbances are creative not merely destructive as viewed in human terms deserves to be heard by as wide an audience as possible. Ecologists, conservationists,

and environmental managers in particular can only benefit from reading this passionately written book.

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### Competition between pasture plants

Tow, P.G. and Lazenby, A. (Editors) 2001. *Competition and succession in pastures*. CABI Publishing, Wallingford, U.K. x + 322pp. Hardback, ISBN: 0-85199-441-5, £65.00 (US\$120.00).

This book will be extremely helpful for anybody working on the ecology and management of sown and native grassland. It is the most comprehensive review of the current state of knowledge on competition in grassland I am aware of. The 15 chapters are written by well known researchers. Half the chapters deal mainly with sown pastures, and the rest cover natural grassland, climate change, and re-created grassland. Each chapter is supported by comprehensive references including both contemporary and classic papers.

In their introductory and concluding chapters, the editors stress the importance of knowledge about competitive relationships, and long-term research, for the long-term stability and productivity of grasslands. This is perfectly true, but it is difficult to see such research being supported in New Zealand. Perhaps several institutions could contribute to the overhead costs of maintaining a couple of research sites in sown and native grassland, so that biotic trends could be monitored over the long haul.

The chapters on sown pastures are directly relevant to the New Zealand scene, and cover the theories of plant competition, measurement, adaptive strategies, grass-clover relationships, and management of competition. There is an interesting contrast between E. Ann Clark's arguments against simple seeds mixtures on top class land, and those of Warwick Harris for simple seed mixtures on such sites. Harris suggests that New Zealand seed merchants' recommendations of complex mixtures are driven by profit. Surely simple mixtures would reduce the overheads of maintaining and selling multiple lines, and be a better commercial option?

Global climate change will provide a continually changing set of factors that impact on competitive relationships. Climate change on its own is a powerful argument for the need for long-term research. One deficiency in the book is the limited discussion of the role of plant breeding as a tool to manage competition for sustainability. Although co-selection for adaptation

between grasses and legumes has been discussed by plant breeders, little practical progress has been made. It is a pity that the book does not carry a major challenge to plant breeders to push forward with co-selection.

The book is attractively presented, and the photographs and diagrams are of better quality than those in many contemporary academic books. Placing footnotes at the end of chapters rather than on the same page as the topic means you have to search for them and this can be disruptive. The index is split into 5 sections which seem unnecessary when the whole index is just over 6 pages long. As a result, the index has a lot of cross-references, and it can be time consuming to track down a specific subject. However these are minor quibbles.

I can strongly recommend this book as a resource for students and researchers with an interest in the interactions of plant species.

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### Ecological heterogeneity — a key factor for understanding biodiversity

Hutchings, M.J., John, E.A. and Stewart, A.J.A. (Editors) 2000. *The ecological consequences of environmental heterogeneity*. British Ecological Society Symposium 40. Blackwell Science, Oxford, U.K. xiii + 434 pp. Paper. ISBN: 0-632-05713-0, £29.95.

The British Ecological Society has, over a period of some years, set a high standard for its published symposia and this new volume is no exception. It is based on a 1999 symposium and is a response to the many recent advances in measurement and interpretation of the impacts of environmental heterogeneity upon biological diversity and ecological processes at a wide range of scales. The broad aim has been to discuss effects of environmental heterogeneity itself, the effects of spatial and temporal heterogeneity on all levels of biodiversity and ecological systems, and the management consequences and conservation implications of heterogeneity. It is a very useful follow up to other recent collective studies that are starting to link research on the dynamics of populations and ecosystems into the bigger picture that is the realm of landscape ecology. This in itself is welcome and a sign of ecological maturity for areas of research that for too long have not spoken effectively with each other.

The book is a well-balanced presentation of landscape heterogeneity theory, case studies dealing with particular sets of organisms and environments, and management issues. One of the problems with publications such as this is that one is drawing together a very heterogeneous authorship that may in itself display little unity in either approach or stance. The editors have avoided this perception through a very well balanced introduction that summarises and harmonises the approaches taken in individual chapters. Three common threads emerge. One is the general pervasiveness of heterogeneity, albeit at different scales. This is not only spatial but also temporal. A second is that while the implications of heterogeneity are well-studied for particular examples of organisms (especially wide ranging mammals) they are much less known at higher levels of biological organization. The third thread concerns the consequences for anthropogenically imposed heterogeneity at the landscape level especially at a range of scales including species and genetic organization.

This collection of papers has particular relevance to New Zealand, a country of small landscapes and high levels of heterogeneity imposed by high beta-diversity and very dynamic habitat processes. On top of this natural heterogeneity there is an imposed new order of human-induced heterogeneity. Although based largely on British examples, Chapters 17 (Ecological experiments in farmland conservation) and 18 (Environmental heterogeneity: effects on plants in restoration ecology) have particular relevance for future management and restoration in production landscapes such as the Canterbury, Hawkes Bay and Waikato lowlands. Chapter 3, which deals with differences between organismic and physical heterogeneity, should be required reading for environmental engineers and landscape designers. It introduces concepts that often do not get a hearing outside research laboratories and academia. A very interesting and relatively understudied area that is explored in this symposium is the role of physical ecosystem engineers — those that physically modify their environment and so affect the environments of other organisms around them, sometimes profoundly. As J.H. Lawton recommends in his closing chapter, there is urgent need for ecologists interested in heterogeneity to take ecosystem engineering much more seriously.

As expected, the volume is very oriented towards northern temperate situations but the principles debated and the examples used have much wider application. It would have been good to have included one or more contributions from a landscape architecture and design perspective — how does one put into practice what ecologists are discovering about heterogeneity. I would also like to have seen specific discussion of the heterogeneity of urban environments and its effect on

natural patterns of distribution, dispersal and regeneration. Lawton's concluding chapter is a masterful drawing together of the threads generated within the bulk of the book chapters. This is based round a series of open questions and problems, and sets something of an agenda for future research. One area that will undoubtedly generate considerable debate is Lawton's challenge to the assumption that climate mapping is key to prediction of future distributions of species, and that there are overlays of environmental heterogeneity and species interactions that mean that ranges and abundances of particular species and their assemblages may change in some very unexpected ways in a rapidly warming world.

Overall this is an interesting and challenging volume that should be on the shelves of many research libraries and the reading lists of senior biology and resource management students.

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### **Resource management as a social science and a natural science?**

Berkes, F., Folke, C. and Colding, J. (Editors) 2000. *Linking social and ecological systems: management practices and social mechanisms for building resilience*. Cambridge University Press, Cambridge, U.K. 476 pp. Paperback; ISBN: 0521785626, £22.95.

Resource management as a social science and a natural science? Just as we were getting used to thinking in terms of "catchment area" rather than individual rivers and multiple species integrated management rather than single species MSY models, now the human dimension is thrown into the loop as well. Berkes and Folke, the editors of *Linking social and ecological systems* challenge us to think about resource management in new ways. Resource and ecosystem management is necessary "but it requires fundamentally different approaches, not mere tinkering with current models and practices" (p. 428).

The overall objective of this book is to illustrate how resource management can be improved through the use of a wider range of information sources and considerations than currently used in conventional resource management science. Berkes *et al.* go beyond musing about why conventional resource management does not work. They bring together a convincing group of scholarly might to show how it can be done better.

There are enough new ideas, theoretical ponderings and critical thinking here to tantalise any scientist, and

enough case studies and examples to make this book a useful tool for any practitioner. The case studies here provide tools, mechanisms and approaches for people-oriented resource management.

The message of this book is that addressing resource management issues is best achieved at the interface of human (social) and natural (ecological) systems. The basic principle is that, over time, people develop ecological knowledge that “fits” the ecosystems upon which they rely for resources. Locally devised systems of both ecological practices and social mechanisms that are flexible, adaptive and social-ecologically appropriate. These practices and mechanisms are better able to manage predictable change (pulses) and unpredictable changes (surprises) in ecosystems, and thus achieve resilient sustainable systems that can secure the flow of natural resource and ecosystem services.

There are two streams of thought that are brought together to secure the social-ecological linkage that is key to resilient ecosystems. The first is the use of systems approaches and adaptive management, with their emphasis on linkages and feedback controls, as described by Holling (1978). The second stream of thought looks at the role of institutions and property rights in achieving sustainable resource systems. These two streams, bringing together resource-focus and resource-user focus, enable an analysis of complex resource management issues in terms of humans-in-nature, or social-ecological systems.

Berkes *et al*, provide concise explanations and case studies of key concepts in these new (or, as the authors point out “rediscovered”) approaches to managing resources. The emphasis is on the integrated concept of humans-in-nature, and thus social-ecological systems are the theme. Concepts such as resilience, traditional ecological knowledge, common property theory, adaptive management, linkages, threshold and surprise are defined. Resiliency is a key theme throughout the book; thinking of social-ecological systems in terms of how resilient (able to buffer change) they can be.

The book is divided into four parts, connected by the common theme of social-ecological resilience and sustainability, and each using a series of international case studies as evidence. *Part one* is about learning from locally-devised systems, and the relevance of local knowledge and experience to resource management. *Part two* focuses on the emergence of resource management adaptations and how local institutions adapt to ecosystems. A case study from the Canadian sub-arctic (Berkes) describes how Cree subsistence fishery management practices violate just about every conservation and management tool used by government managers, and yet they maintain consistent fish age-class composition and a sustainable food source. The key, accorded to Berkes, is that management practices as rotations, pulse harvesting,

maintaining multi-age classes and renewing over-mature natural systems have adapted to sub-arctic ecosystems which are characterized by low biological productivity and a high degree of year-to-year variability. *Part three* moves from community-based systems to case studies about success and failure in regional systems. These studies analyse the linkages between local systems embedded within larger regional, national and global systems. Finlayson and McCay’s chapter shows how the collapse of the Canadian east coast cod fishery is better understood in the context of national policies that encouraged large-scale off-shore fisheries and centralised scientific authority, rather than the lack of regulations or excessive numbers of local fishing. In *Part four*, the authors combine the lessons of the earlier case studies, and turn their attention to designing new approaches to management. The focus is on combining local expertise (often termed traditional ecological knowledge) and traditional management practices with scientific knowledge and conventional management. In the last chapter, the editors bring the message home. First, they summarize social-ecological practices and mechanism for resilience and sustainability. These include management practices based on ecological knowledge, such as resource rotation, management of succession, monitoring ecosystem change, and nurturing sources of renewal, and social mechanisms behind the management practices, including the transmission of ecological knowledge through generations, cross-scale institutions, taboos and regulations, and cultural values such as sharing and reciprocity. Finally, seven new “rediscovered” principles of environmental management are suggested. If any part of the book is to be secured to memory, it is these principles. Take these and go forth, oh resource managers of the world.

This book was ahead of its time when it came out in 2000, and probably still is. And yet Berkes, Folke and Colding have taken the linked social-ecological systems notion further in two more recent publications 1) “Back to the Future: ecosystem dynamics and local knowledge”, In: *Panarchy: understanding transformations in human and natural systems* (L. H. Gunderson and C. S. Holling, editors. Island Press, pp. 121-146 (2002); 2) “Rediscovery of traditional ecological knowledge as adaptive management”, *Ecological Applications 10*: 1251-1262 (2000).

A final cautionary note: this book may cause interdisciplinary mingling in the hallways of government, university and other research institutions.

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### Home, home on the range...

Vallentine, J. F. 2001. *Grazing management* (Second Edition). Academic Press, San Diego, U.S.A. Xii + 659 pp. Hardback, ISBN: 0-12-710001-6. £59.95.

This second edition of John Vallentine's *Grazing Management* appears 10 years after the first edition, and has substantially wider coverage. The book is divided into 16 chapters covering all aspects of the interactions between grazing animals and the plants being grazed, with considerable emphasis on controlling the interactions. It is unusual now to find such a wide-ranging work produced by a sole author, and the book is a testament to the career of the Emeritus Professor of Range Science at Brigham Young University, Utah.

The book deals with American rangelands, with many examples taken from Utah, Nebraska and Texas. This means it has limited relevance in New Zealand, even in our high country grassland, where the climate and vegetation structure are quite different from the rangelands of the western United States.

It is interesting to note the focus throughout on profitable farming use of the rangelands. Conservation and biodiversity issues are not mentioned, and soil and water quality issues are covered in a few pages. The final chapter is headed 'Grazing as an environmental tool' but still the emphasis is on using grazing strategies to improve the forage supply for farmed animals. Multiple use of rangeland gets three lines: "livestock owners cannot be expected to utilize their animals to enhance wildlife habitat or other vegetation manipulation if livestock performance will be substantially reduced unless otherwise reimbursed for such under-performance". There is no questioning of the long-term sustainability of the rangeland practices being advocated, and no alternative future scenarios are investigated.

The print is easy to read, and there is an excellent glossary and an extensive list of references. In many ways the attitudes towards vegetation use in this book are dated. New Zealand ecologists will find little of value here, as we move towards land management systems that satisfy multiple goals.

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