Book Reviews

Space: The final frontier for ecology?

Dieckmann, U., Law, R., and Metz, J.A.J. (Editors) 2000. *The geometry of ecological interactions: simplifying spatial complexity.* Cambridge Studies in Adaptive Dynamics. Cambridge University Press, Cambridge, U.K. xiv + 564 pages. Cloth, ISBN: 0-521-64294-9, £47.50.

Classical approaches to understanding ecological dynamics relied on models with low dimensionality and an assumption of spatial homogeneity. This approach, in which a given individual in the system interacts equally with all other individuals, and all individuals see the same ('mean') environment is referred to as 'the mean field approximation'. Over the last 10–15 years, however, the importance of space and spatial pattern in an ecological context has been increasingly emphasised, and the weaknesses in the mean-field approach have become clear. A critique of the mean-field approach is at the heart of this book. *The geometry of ecological interactions* provides an excellent introduction to the state of the art in the tools used to describe ecological dynamics in spatially structured populations. A central premise of the book is that the mean field approach does not provide us with a good model of ecological dynamics and that we need to develop new analytical, and other, techniques to explore spatio-temporal ecological patterns and processes.

The book is divided into four parts: (A) Empirical and statistical background: a plant ecological perspective, (B) When the mean-field approximation breaks down, (C) Simplifying spatial complexity: examples, and, (D) Simplifying spatial complexity: techniques. These four sections move from field observations to individual-based simulation models to deterministic approximations of stochastic spatial systems. The first section explores what we have learned about spatio-temporal ecological processes from field studies, with an emphasis on temperate grassland systems. A particularly interesting chapter is that by Jonathan Silvertown and Bastow Wilson which describes appropriate methods for the design and analysis of spatial competition studies in the field. The need for theoretical studies to be based on empirical observations is emphasised.

The second section considers some of the techniques/methods available when the mean field approximation proves inadequate. Two broad approaches are described: grid-based models (similar to cellular automata), in a chapter by Wissel, and reaction-diffusion type partial differential equations (PDEs) in chapters by Cronhjort and Boerjlijst — the chapter by Cronhjort, which explicitly compares the two approaches, is particularly valuable.

The final two sections describe methods for the simplification and analysis of spatial complexity, with an emphasis on the pair approximation method and moment closures. The pair approximation method provides a way of developing analytically tractable deterministic approximations of stochastic spatial models. In grid-based models a given individual's behaviour is a function of just a few neighbouring individuals, and so, if those neighbours are equivalent and act additively on births, deaths, and movements, average rates for these three processes depend only on the average number of neighbours. Building on this premise, pair approximations can be developed that can describe, with some success, ecological dynamics under small-scale spatial heterogeneity. The development of these techniques lies at the forefront of recent research in spatial ecological theory. Section C describes the application of such methods; for example, Iwasa shows how they have been successfully applied in bacterial competition and forest dynamics. Section D discusses the development of pair approximations and moment closures in both discrete and continuous space; for example, Sato and Iwasa outline how pair approximations can be applied to lattice models, and Bolker *et al*. describe the application of pair approximation methods in continuous space in the context of dispersal and competition. The range of applications discussed in Section C is much broader than the suite of techniques discussed in Section D.

Despite being an edited book (with some 37 contributors) comprising 24 chapters (516 pages), *The geometry of ecological interactions* is cohesive and the wide-range of subject matter covered is clearly integrated. The reference list (which includes the page(s) on which the citation occurs) and the index are also both good. The book clearly has a wide remit, from ecological field-studies to mathematics and back. Furthermore, a very wide range of case-studies (model and field) from a diversity of systems (from replicators in prebiotic evolution, to the spread of rabies, to fire in the boreal forest) reinforce the wide applicability of the concepts and techniques being introduced. In places the mathematics used in the book is certainly daunting, but *The geometry of ecological interactions* provides an excellent coverage and review of new methods (such as pair approximations and moment

closure) that is unavailable elsewhere. In this context a positive feature is the inclusion of boxed material throughout the book that explains in detail some of the more technical material. Overall, I would certainly recommend *The geometry of ecological interactions* to graduate students and researchers interested in the field of spatial ecology. It is a challenging read, even though it is generally well written; it is also an exciting and stimulating one, providing a glimpse of where ecology may be headed in the next ten years.

George L.W. Perry
Department of Geography
King's College, University of London
London WC2R 2LS, U.K.

Parasitology = ecology

Combes, C. 2001. *Parasitism: The ecology and evolution of intimate interactions*. The University of Chicago Press, Chicago, U.S.A. xiii + 728 pp. Cloth, ISBN: 0-226-11445-7, US$55.00.

There are many obvious questions in ecology to which there are, as yet, no satisfactory explanations. One which springs to mind (and is often a favourite with junior school children) is 'Why does the Zebra have black and white stripes?' Two of the more common answers to this question are either that the Zebra was burnt by a campfire as he fought over a pool of water (African Bushman tale) or that it is an adaptation by the Zebra to hide from predators among savannah grass (general ecology theory). However, it may not be just one of these answers which is a myth. Recent evidence suggests that the striped pattern is, in fact, an adaptation to avoid being bitten by tsetse flies (biting arthropods being attracted to large unit areas) and that it is the fitness cost of contracting a debilitating disease being transmitted by such flies, rather than the fitness cost of being caught by a predator, that has resulted in the observed Zebra phenotype. This is but one of a wealth of fascinating examples that Combes pulls together from diverse sources in the literature to illustrate the profound role which parasites play at all levels from the molecule to the ecosystem. Such examples, combined with a compelling writing style that reflects Combes' obvious love and fascination for his subject matter, makes *Parasitism* essential reading. It is perhaps the most useful and complete synthesis of parasitological thought to date.

In its approach, *Parasitism* is unique. Rather than being yet another stale catalogue of parasite morphology and life history, the book lends a more functional slant to the subject, exploring the complex patterns often associated with host/parasite interactions in the more general terms of cost/benefit optimisation tempered by historical constraints. In doing so this is truly a step forward in integrating parasitology with mainstream ecology and evolutionary biology. The author goes out of his way to address common misconceptions, clarify confusing issues, and do away with unhelpful specialist jargon in favour of unifying definitions with mainstream ecology. Furthermore, this is a book that makes you think. In bringing what are often novel and unique viewpoints to many aspects of parasitology, ecology, and evolution in general, Combes has produced a textbook that is not only stimulating but a joy to read (not something often associated with textbooks!). You may not agree with many of the points Combes raises, but he does make you re-examine many aspects of biology you had previously taken for granted.

The book does have some peculiarities, however, having been translated from an earlier French edition. In general the translation has been extremely well accomplished although some phrases can be slightly confusing. The upside to this, however, is that the book contains references to a wealth of European and Russian work not previously published in English. The book is well structured, being divided into sections on ecology, evolution and interactions, but is lacking in one noticeable area. While most subjects are covered in an impressive depth, there is next to no information on modern epidemiology where, arguably, some of the most important advances in parasitology have been made in recent years. Less than three pages of text are devoted to this subject, with the discussion ending in 1978 with reference to Anderson and May. However, in all other fields, Combes does a good job of synthesising the current state of knowledge, and highlights areas where further research is required. This book is thus an essential read for all parasitologists, an essential reference text for all ecologists and evolutionary biologists, and, being detailed with a wealth of insightful illustrations, is an extremely useful source for teaching material.

Daniel M. Tompkins
Department of Zoology
University of Otago
P.O. Box 56
Dunedin, New Zealand

Wild about diseases

Hudson, P.J., Rizzoli, A., Grenfell, B.T., Heesterbeek, H. and Dobson, A.P. (Editors) 2002. *The ecology of wildlife diseases*. Oxford University Press, Oxford, U.K. xii + 197 pp. Paperback, ISBN: 0-19-850619-8, £24.95.

Despite not being as conspicuous as predators, parasites and diseases are now recognised as major players in animal population dynamics and community structure. In New Zealand, recent reports of frog mortality linked to chytrid fungus and penguin mortality associated with malaria have highlighted how little we understand the emergence, spread, maintenance and impact of wildlife diseases. Bovine Tb and the role of brushtail possums as reservoir hosts, or the recent and unsuccessful attempt at controlling rabbits using a calicivirus, also come to mind. In this context, this new book is welcome.

The book is the outcome of a meeting of 50 wildlife epidemiologists held at Trento, Italy. It is not a conference proceedings, however. The book was planned at the meeting, and the editors and publishers are to be congratulated for restricting the variance in quality, clarity and style among chapters, a typical problem with edited volumes. Each chapter is written by several people (averaging almost ten per chapter), but the lead authors did an excellent job of integrating the many contributions into coherent chapters that flow logically and smoothly. In places I got the feeling that efforts were being made to include every contributor's favourite case studies, but this did not detract from the main arguments. All chapters have the same structure, beginning with clear statements of objectives in the form of questions, followed by some background, the theory, and a summary of the current state of knowledge. Case studies and the finer points of mathematical models have been relegated to boxes, and do not clutter the main text.

Sandwiched between a first chapter that sets the stage and a final one that provides visions for future research, the seven core chapters explore different aspects of wildlife disease ecology. The topics covered include the patterns and causes of heterogeneity in infection levels among individual animals, the impact of parasites on host population dynamics, the determinants of disease transmission and persistence, the spatial component of disease ecology, and the role of pathogens in conservation biology. Throughout, a major effort is made to integrate empirical and theoretical studies of infectious disease ecology into a common framework. There is also a conscious effort to unify the perspectives from different fields such as population ecology, epidemiology, evolutionary biology, genetics, molecular biology and immunology. The authors have succeeded in conveying to the readers the excitement that can result from this synergy, and they provide the research questions that will ensure its future growth.

The book was not necessarily aimed at students, but is generally so clearly presented that it would make a useful text for an advanced course in wildlife population ecology. For the professional wildlife ecologist, however, it should be compulsory reading. It is not a reference book that sits on a shelf until consulted to verify a minor fact, but rather a stimulating summary of what we know now and what we need to find out soon. I suspect it will be an eye-opener for many, but with the recently increasing rate of emerging diseases worldwide, it should provide much needed guidance.

Robert Poulin
Department of Zoology
University of Otago
P.O. Box 56
Dunedin, New Zealand

Predictions and prognoses

Jørgensen, S.E. and G. Bendoricchio. 2001. *Fundamentals of ecological modelling*. Third edition. Elsevier, Oxford, U.K. xii + 530 pp. Cloth, ISBN:0-080-44015-0, US$82.00.

This volume is a wonderful resource for the environmental or ecosystem modeller. It is packed with useful references, ecological processes and models of mainly aquatic systems. The types of model described cover a wide range, from static models to artificial neural networks. In this edition, as in the previous ones, Jørgensen presents a very down-to-earth view of models and their uses. Curiously, for a book on modelling, the word 'prediction' is barely mentioned. Instead, 'prognosis' is used whenever a forecast is meant. Whether any significance should be attached to this usage is not clear. Perhaps the authors feel 'prognosis' better reflects the uncertainty associated with model forecasts.

Despite the authors' claim that this edition is introductory and only a fundamental knowledge of differential equations and matrix calculations is required, the chapters that discuss specific models are relatively dense, mathematically. For those who are challenged by the partial differential, a comprehensive appendix has been provided to help refresh the reader about concepts that may be but dim memories. I felt compelled to read the appendix (written by Poul Hansen) first. Those who have avoided anything quantitative in their career often ask me what they should read to help

them understand the mathematical basis of models and modelling. While I'm certain the only remedy is formal study with its associated discipline, I felt I should assess this section. Its chatty style persuades one to read on. The examples following each major section are helpful but those who are truly maths averse will find the material difficult without close study. The authors' use of the word 'nicer' as the maths become more complex, is also somewhat unnerving. As a population ecologist, I found the chemical and physical knowledge required to follow the content in the body of the book more challenging.

The book is well laid out with an abundance of figures and discursive content to illustrate concepts. There are a number of minor errors throughout the volume and these become particularly numerous in the appendix. Unfortunately, in this day and age, the use of non-inclusive language, although infrequent, stands out like a beacon.

Ecologists who want to find out more about modelling will find the first two chapters and the last chapter the most interesting. In the first edition, Jørgensen provided one of the earliest detailed commentaries of the purpose of models and modelling procedure. In this edition the material has been greatly expanded. Chapter 1 gives a good perspective on why models are created. Chapter 2 gives an in-depth, step-by-step discussion of how to develop models. Important topics covered in Chapter 2 are parameter estimation, calibration, sensitivity analysis, validation, and model constraints. Chapter 3 describes important chemical, physical and ecotoxicological processes that environmental and ecosystem modellers can use. Useful methods, particularly the different types of conceptual diagram used to represent models, are described in Chapter 4.

The biogeochemical and ecotoxicological models presented in Chapters 5-8 are given in sufficient detail that ecologists who are specialists in these areas should be able to develop similar models of their own. Chapter 6 deals with population dynamics, but is a little disappointing. Population ecologists who might be interested in this volume would probably prefer to find this chapter more informative. They would be better to read the book on which the illustrations in that chapter are based. While still an excellent illustration of the use of matrices to model stage structured populations, Usher's blue whale matrix model has been somewhat thrashed in ecological modelling texts. One can't help wondering where all the new examples are?

The final chapter that describes recent developments in ecological and environmental modelling is much needed. Following a discussion of the characteristics of ecosystems and variable parameter models (that sometimes drifts into the arcane), the authors illustrate application of chaos and catastrophe theories. Newer modelling techniques, such as individual based models, object orientated models, fuzzy knowledge and artificial intelligence are discussed. Of special note is the readable description of artificial neural networks that have recently found useful application in ecosystem studies.

Susan P. Worner
Ecology and Entomology Group
Soil Plant and Ecological Sciences
Lincoln University
P.O. Box 84
Lincoln, New Zealand

Wildlife study design: staying practical and obtaining reliable inference about a messy world

Morrison, M.L; Block, W.M.; Strickland, M.D; Kendall, W.L. 2001. *Wildlife study design.* Springer-Verlag, New York, U.S.A. ix + 210 pp. Cloth, ISBN 0-387-95118-0, US$44.95.

This superbly practical, medium-length text covering wildlife and environmental research design will be useful for experienced wildlife researchers and advanced post-graduate students alike. It reminds us of the basics of scientific method, the importance of hypotheses, the need for clear definitions of populations and for restricting zones of inference to the domain sampled. The relative power and limitations of experimental, observational and modelling approaches are discussed, and the forced reliance of wildlife researchers and managers on quasi-experimental approaches and a judicious mixture of experimental and observational studies is acknowledged. The authors do not flinch from underscoring the need for replication and adequate sample sizes, but they also rank options for obtaining the most reliable inferences from available resources or opportunities. The practical realities faced by wildlife managers are not emphasised to create a screen to hide or accept poor science design — rather this is a call for all the more emphasis on rigorous and efficient design and safe interpretation of results. Best of all are the strong opinions expressed by the authors on the relative utility of different approaches and calls for common sense — calls that obviously stem from real-life experience and will assist emerging wildlife researchers avoid a "paralysis by analysis" when confronting a complex design problem armed with very limited time, budgets or sampling space.

Use of several and varied practical examples of studies of "wildlife" (defined as vertebrates in the text, but the design issues are equally relevant to the spineless) from U.S.A. illustrate concrete solutions to problems familiar to New Zealanders. Environmental

impact assessment, conservation, pest control, harvest management and theoretical population and community processes are illustrated.

The authors demonstrate clear understanding of applied ecology and marry it with authoritative and up-to-date treatment of statistical and experimental design. The basics of population and community processes, potential pitfalls from meta-population structures, and the complex and multi-dimensional characteristics of ecology are emphasised as potentially confounding simpler statistical models for design and analysis. The potential value and constraints of adaptive resource management as a substitute for classical research design is given due emphasis. The repeated ecological science caveats offered by these expert statisticians and research designers give me confidence in their advice. This text is not a statistical tool-kit or recipe book — plenty of those exist elsewhere. This text's outstanding contribution is in providing a succinct higher-level discussion on the overall design issues rather than step-by-step guides to application. Several salient references are provided for in-depth follow-up. I found just enough detail and reference to the key contributors in the areas of study design that I am familiar with to be confident that the material in new areas for me will be comprehensive.

The only substantive gap I can detect is an absence of consideration of meta-analysis as a useful tool for obtaining reliable inference. Meta-analysis is gaining popularity amongst medical researchers, behaviourists and environmental researchers as a formal tool for divining generality from scores of similar experiments, each of which is poorly replicated because of ethical and practical constraints. I also regretted a lack of partitioning relative from absolute abundance measures (I think the distinction is useful in forcing emphasis on the potential interference of changing detectability or interception probability when comparing relative indices between habitats, times, places, etc.). The organisation of the material was slightly repetitive. Some of the formal mathematical expressions will do little to help most of the readers understand the underlying concepts that are well-explained by text anyway (I suspect some mathematicians find it hard to resist adding these to display a badge of their craft!). But these were minor bugbears amidst my general admiration for a very useful text.

I heartily recommend *Wildlife study design* for New Zealand wildlife and environmental students, researchers and managers.

Henrik Moller
Zoology Department
University of Otago
P.O. Box 56
Dunedin, New Zealand

Slugs and snails and plenty of details

Barker, G.M. (Editor) 2001. *The biology of terrestrial molluscs*. CABI Publishing, Wallingford, U.K. xiv + 558 pp. Cloth, ISBN: 0-85199-318-4, £75.00.

In 14 chapters, 22 authors write about numerous features of the land molluscs: evolution, genetics, anatomy (including a whole chapter on the radula), blood physiology, reproduction (including gametogenesis and gamete morphology), feeding, life history and behaviour. Thus this book provides a useful introduction to almost all aspects of terrestrial gastropod biology. As in many such books, this entry is often via the bibliography and, commendably, every chapter has extensive reference lists. The down-side is that (as one group of authors notes) the lag time between submission and publication means these lists are immediately dated. The access enjoyed by many scientists nowadays to bibliographic search engines, however, means this problem is less important. Indeed, it can be argued it is more important to have the earlier papers cited as these are less likely to be found in such searches. The book has clearly been written with an expert reader in mind, but I would have found a glossary useful: do ditrematous (page 79) and diatrematic (page 312) mean the same thing?

Barker's own contribution outlines the diversity of terrestrial gastropods and to me was the most interesting section. The length of this chapter, over 25% of the book, is an indication of just how varied slugs and snails are: the shift to land has occurred at least four times in the evolutionary past and there are an estimated 35 000 living terrestrial species. Nevertheless, while Barker has compiled a huge amount of information about the various groups, it is clear that as yet we know very little about a great deal. For instance, our understanding of the phylogeny of the largest group, the Pulmonata, is rudimentary: Barker presents some of the first trees derived using modern cladistic techniques, but the level of trust we can put in most of the branches is not great. The subsequent chapters also succeed in bringing together a wealth of work, but again demonstrate how much we have to learn. Dimitriadis' chapter even notes that improvements in our knowledge of the molluscan digestive system in the past 20 years have been small. Recently developed techniques need to be applied and the eurocentric bias in the species examined must be rectified.

Indeed, from a New Zealand ecologist's viewpoint, the most unsatisfactory aspect of the book is the dearth of attention to neozelanic species. This virtual absence is all the more grating in light of New Zealand's almost unrivalled sympatric diversity of species: just under 900 stylommatophorans (many undescribed) are found

on land within the EEZ and over 60 species can be found together within small pieces of forest. Only Barker's chapter contains more than a passing mention and even there typographical errors (e.g. *Onchidium nigrans* for *Onchidella nigricans*) will mean these snippets are hard to find. But maybe New Zealand ecologists should take this deficiency as a challenge, and investigate in detail Schilthuizen's (2002) claim that "snails and their kin are ideal subjects for a range of ecological and evolutionary research fields".

Reference

Schithuizen, M. 2002. Mollusca: an evolutionary cornucopia. *Trends in ecology and evolution 17:* 8-9.

Hamish G. Spencer
Department of Zoology
University of Otago
P.O. Box 56
Dunedin, New Zealand

Finding the botanical beasts lurking in suitcases and gardens

Groves, R.H.; Panetta, F.D. and Virtue, J.G. (Editors) 2001. *Weed risk assessment.* CSIRO Publishing, Collingwood, Australia. x + 244 pp. Paper, ISBN 0-643-06561-X, AUS$80.00.

The world is no longer as big as it once was. Individuals of any species that can hitch or smuggle a ride via our extensive international trade networks can now disperse across vast previously insurmountable ocean barriers. This breakdown of natural dispersal barriers has occurred most frequently with plants, since numerous industries spread plant species around the world with great enthusiasm. As a consequence, rates of plant immigration are now tens of thousands of times greater than historical rates (Tye, Chapter 12).

Faced with this *tsunami* of plant species flooding into ecosystems, ecologists, conservationists and land managers around the world are struggling to determine where best to direct their limited resources. For example, which plant species should we attempt to block from importation (and exportation)? Which established weed species and cultivated potential weed species should we target for control or eradication?

If you want to know how far we have come with answering these difficult questions, *Weed risk assessment* is an excellent place to turn. This multi-authored volume explores the state-of-the-art in 'weed risk assessment' (WRA). Weed risk assessment encompasses the various approaches and models used both to set priorities for the control of established foreign weeds, and to assess the likely invasiveness (i.e. how well weeds will spread) and weediness (i.e. how detrimental their impacts will be) of proposed plant imports.

The book begins with several stimulating discussions of the enormous biological and statistical challenges to the accurate assessment of the likely invasiveness and weediness of plant species. Williamson (Chapter 3) and Lonsdale and Smith (Chapter 5) give particularly thorough reviews of these challenges. For example, plants in new environments can not be expected to behave as they do in their native ranges, since physical and especially biological conditions will differ greatly (Chapter 3). Kriticos and Randall (Chapter 6) inadvertently give an illustration of this, in their useful assessment of climate models for predicting potential weed distributions. They find that the climatic conditions within the native range of the Brazilian cactus *Cereus jamacaru* predict a dramatically smaller potential range for the species in Australia, than do the climatic conditions within the feral distribution of the same species in South Africa.

Such difficulties aside, the need for practical and accurate WRA systems is urgent. The many subsequent chapters supply examples of the development and implementation of WRA systems, both nationally and regionally, from Australasia and the Americas. These systems usually score species against a number of basic truths about most of today's weeds. Is the species a weed elsewhere, and does it have characteristics that predispose it to spread rapidly (e.g. fast growth, early maturation, many well-dispersing seeds, etc.), make control difficult (e.g. persistent seed banks, etc.), and have large detrimental impacts (e.g., poisonous, flammable, etc.)? [An exception is Hawai'i (Chapter 13), which still set priorities for existing weeds with a subjective "expert-based" selection process].

The quantitative WRA methods are simple enough for widespread application and objective enough to be defendable before bureaucrats and politicians. Initial indications are that they can also be surprisingly accurate (Reichard, Chapter 2), although there are some serious misgivings about current methods of evaluation (Chapters 3, 5). To quote Lonsdale and Smith (p. 59), 'the current screening systems are a creditable beginning, but we remain cautious... as to their explanatory power.' I am also concerned that many WRA methods may be overemphasising today's weeds — fast moving, disturbance-loving plants that readily reach problematic densities and distributions — at the expense of excluding/controlling tomorrow's weeds. It is the slow-maturing, shade-tolerant woody forest species, requiring several centuries to reach weed proportions, that may cause the most serious long-term alterations to native forest ecosystems.

Within these latter chapters are also some excellent accounts of the historical and ecological processes

influencing plant invasion in various counties. A highlight is Mulvaney's (Chapter 15) admirably thorough account of the historical factors controlling the naturalisation (i.e. becoming feral) of foreign ornamental woody plant species in south-eastern Australia. The highest naturalisation rates, close to 25%, are for the most commonly planted species and the species planted *c.* 200 years ago. These findings emphasise a critical need to think long-term when assessing likely invasiveness, and to apply WRA screening processes to species already cultivated in a country.

While this book is a gold mine of information and references, an adequate exploration of how field monitoring systems should be incorporated into WRAs is missing. Given the inaccuracies expected in current WRA systems, it is wise to expect the unexpected and monitor accordingly. How best to do this is an area of active research that is only touched on here.

This is undoubtedly an important volume, and a landmark for the beginning of a task that is certain to test the mettle of plant ecology. It is essential reading for ecologists and biosecurity staff working at the front lines of the weed invasion, and provides a practical introduction for ecologists considering joining the fight.

Jon J. Sullivan
Manaaki Whenua — Landcare Research
Private Bag 92 170
Auckland, New Zealand

Competition: reviewing and scrutinizing the ecologist's toolbox

Keddy, P.A. 2001. *Competition*. Second Edition. Population and Community Biology Series Volume 26. Kluwer Academic Publishers, Dordrecht, The Netherlands. 552 pages. Cloth, ISBN: 0-792-36064-8, £140.00.

Competition has long captured the attention of ecologists, perhaps because it is one of the fundamental ways in which species interact, or perhaps because of historical legacies. Don't let the book title steer you away from a supposed specialist topic however; the scope of this book is much wider than the title suggests. Rather than an exhaustive review of competition, Keddy uses the theme of competition to better understand the natural world, and also to expose the strengths and shortcomings of various approaches to understanding ecological questions.

Some major changes have been made from the first edition of the book: the second edition is much bigger (about twice as long as the first edition), it is printed by a new publisher, and the extent of human examples of competition has filled many of the new pages. This latter change may be unwelcome news for readers who disliked the material on human history and conflict among nations or civilizations in the first edition. It is unconventional, or at the very least unusual, to find so many references to the human condition in a book that is part of a series on population and community biology.

The book covers many topics in its 11 chapters, including the study of competition, the role of resources, several chapters on approaches and tools used to study competition, an expanded chapter on modelling, and two closing chapters that tie the material together and put it into a wider scientific framework. The text is clearly written and succinct. The referencing is extremely good, and many excellent examples and case studies are given to emphasize major points throughout the text. Each chapter ends with a set of questions for discussion; these are mostly designed to apply and extend key concepts in a broader framework rather than reiterate the contents of each chapter. Throughout the book, Keddy challenges us to ask clear questions in the first instance, and then to choose the appropriate tools to answer them.

Parts of the text are not ideal reading for the thin-skinned. Keddy voices strong opinions on a variety of topics, some of which do not bear directly on the theme of competition. For example: "Ordination is widely overused. Perhaps it is far easier to collect data than to ask clear questions, perhaps there is a false sense of sophistication from having a computer package simplify the data" (p. 161). Whether you agree with these opinions or not, reading this book will certainly elicit some strong responses! Personally, I like having someone challenge me on a topic; I don't think anyone reading *Competition* will come away indifferent to its contents.

Competition is a good read that will get you thinking in new ways about both competition in particular, and ecology as a discipline. I highly recommend reading this book for challenging ideas and opinions even if you don't have a strong interest in competition *per se*. One of the biggest drawbacks to the second edition is the price tag of £140.00 for a cloth edition of the book. As an unfortunate result, I suspect few individuals will be buying this book, and unless an inexpensive paperback version is released, it will also be prohibitively expensive for use in teaching advanced undergraduate or graduate classes.

Duane Peltzer
Landcare Research
P.O. Box 69
Lincoln, New Zealand

Space travel may still have a long nay to go, bur the notion of archaeological research and heritage management in space is already concerning scientists and environmentalists. In 1993, University of Hawaiiâ€™s anthropologist Ben Finney, who for much of his career has studied the technology once used by Polynesians to colonize islands in the Pacific, suggested that it would not be premature to begin thinking about the archaeology of Russian and American aerospace sites on the Moon and Mars.Â There is a wealth of important archaeological sites from the history of space exploration on the Moon and Mars and measures need to be taken to protect these sites.