
Book reviews

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Experimental Design and Data Analysis for Biologists,
eds G. P. QUINN & M. J. KEOUGH. xvii + 537 pp.
Cambridge: Cambridge University Press (2002).
£29.95 (US\$45.00) (paperback).
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£75.00 (US\$110.00) (hardback).
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The importance of good statistical practice in the design and analysis of biological experiments will be appreciated by anyone who has experienced the problem of trying to interpret complex and variable biological data. This book emphasizes the need for biologists to have a sound working knowledge of the wide range of statistical methods and techniques currently available for biological research and presents a wide range of examples from ecology. Although the primary readership is likely to be drawn from biologists working in quantitative ecology, the range and scope of the material is very wide and many of the techniques discussed in the book will be of interest to workers in other areas of plant and animal research.

The book opens with a discussion of scientific methodology, statistical estimation and hypothesis testing. The authors place considerable emphasis on the null hypothesis test, an approach that some statisticians now regard as unduly restrictive. However, the authors give a fair critique of the methodology and provide a good discussion of the issues involved. Subsequently, there is a chapter on the graphical exploration of data and this is immediately followed by two chapters on the analysis of data by standard correlation and regression methods. The references in the book are drawn mainly from the ecological literature and I missed some of the primary references on regression and regression diagnostics. I also thought the discussion of Type II regression models could have been strengthened by some discussion of the key idea of regression to the mean in a stable population. However, overall, I thought the regression modelling sections were very well presented.

There then follow several chapters covering the basics of random sampling, the design of experiments

and the power of designs to detect effects of interest. The coverage is reasonably thorough and includes all the major classes of crossed and nested factorial treatment designs and all the major classes of block designs. There is a short discussion of fractionation for two-level factorial designs but I found no discussion of the important topic of fractionation for general factorial designs with quantitative level factors. Although such designs are often regarded as ‘industrial’, treatment factors with quantitative levels are, in fact, very common in biology and designs specifically intended to estimate polynomial effects can give substantially increased efficiency compared with conventional factorial or fractional factorial designs. Unfortunately, such designs appear to be little used by biologists and I was sorry that the authors did not mention them. A further chapter is devoted exclusively to the important topic of the analysis of covariance and this is followed by a wide-ranging chapter covering generalizations of the classical linear model. This chapter covers generalized linear and logistic regression models, generalized additive models and models for correlated data including random effects models and generalized estimating equations (GEE) models. There is then a useful single-chapter overview of the analysis of count and frequency data by contingency table analysis and log-linear models.

Most of the remainder of the book is devoted to a substantial discussion of multivariate methods for biological data analysis. Modern computing facilities have made a wide range of multivariate techniques available to the non-specialist and choosing the most appropriate technique for a particular data set can be problematic. For this reason, substantive practical examples of multivariate analysis are especially valuable. Quantitative ecology is an area where multivariate methods seem to have a genuine and natural application and I thought the ecology examples presented in this book gave genuine insight into the use of multivariate methods in biology. I thought the chapters on multivariate analysis were excellent. Finally, the last chapter covers the presentation of results and gives examples of both good and bad presentation of data from the applied biological literature. Again, I thought this chapter was excellent.

In general, the book is well written and well presented with a good range of interesting and realistic

examples displayed in discrete text boxes and with an attractive layout. However, I did think that some of the examples were presented in an overly concise format. For example, Box 11.2 shows an experiment on cane toad response to hypoxia in illustrating a repeated measures analysis and I found that I had to deduce the numbers of toads used for the experimental treatments by examining the numbers of degrees of freedom in the analysis of variance table. Furthermore, there are a few mistakes or typesetting errors. For example, the regression equation in Box 6.4 shows pre-multiplication of the design matrix by a vector of model parameters instead of post-multiplication. However, these are very minor issues and, overall, I thought the book gave a very substantial and worthwhile study of good statistical practice in the design and analysis of biological experiments. I recommend it to anyone involved in quantitative biological research.

Further information about the book and the example data sets used in the book is given by the authors at <http://www.zoology.unimelb.edu.au/qkstats>.

R. N. EDMONDSON

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Modelling and Parameterization of the Soil–Plant–Atmosphere System – A Comparison of Potato Growth Models, edited by P. KABAT, B. MARSHALL, B. J. VAN DEN BROEK, J. VOS & H. VAN KEULEN. vii + 513 pp. Wageningen Pers, Wageningen (1995). ISBN 90 74134 16 5.

This book stems from a workshop held in Wageningen, The Netherlands, in 1990 on modelling potato growth. It is divided into five parts and includes the work of 39 authors in a total of 18 chapters. The first part gives an introduction to the book and its aims. The second part gives an overview of considerations for producing models of the soil–plant–atmosphere system, and includes sections on plant processes, meteorology, soil water dynamics and nutrient dynamics. To some extent this section would be useful to anyone with an interest in growth and development of potatoes, even if they are not interested in modelling.

The rest of the book is centred around a comparison of seven models (an eighth model is also described but not compared because it was developed using the data used to test the others). The developers of these models were each given the same set of field data on potato growth, collected over two years in Scotland, with which to calibrate their models. For a further

two years the modellers were given data on crop husbandry (e.g. planting date, fertilizer and water applications), soil characteristics, and weather, and asked to make predictions about crop development and yield. The field trials are described in the third part of the book, and included optimal, water limited, and nutrient limited treatments, though not all of the models were able to model the nutrient limited conditions. The fourth part describes each of the models in turn and the fifth part provides a comparison of the models in qualitative, graphical and statistical terms and tries to draw out some lessons from the different approaches used.

Although not an introductory level textbook on modelling soil–plant–atmosphere systems, the book is structured to give a good overview of the subject (with an emphasis on potatoes) and is more than just a set of conference proceedings. It will mainly be of interest to people involved in developing crop growth models or anyone working with the particular models included (ISPOTA, MODULES, WOFOST, SWACROP, CROPWATN, Potato-SoilWat and SUBSTOR). Whilst it focuses on potato growth, as the authors also point out, many features of these models will be common to most crop growth models and indeed, some of the models described were not developed specifically for potato crops.

Although the book was published in 1995, the mechanisms and philosophies embodied in these models probably still form the backbone of most crop growth models in use or being developed today. The text, therefore, would still provide some useful ideas to anyone embarking on a new crop modelling project or who is interested to see the relative success of a range of different approaches to modelling crop growth.

J. TOWNEND

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Crop–Water–Simulation Models in Practice, edited by L. S. PEREIRA, B. J. VAN DEN BROEK, P. KABAT & R. G. ALLEN. vi + 339 pp. Wageningen Pers, Wageningen (1995). €70.00
ISBN 90 74134 26 2.

This book presents selected papers from the 2nd Workshop on Crop–Water–Models held at the ICID Congress in The Hague, The Netherlands in 1993. It is presented as a collection of papers, each describing a different model. These are grouped into sections on (i) soil water balance simulation models for irrigation scheduling, (ii) water fluxes and crop

growth simulation models and (iii) models for irrigation management at system level. The main criteria for inclusion in the book were that models must have been validated and calibrated against field data and that software already exists which users could access in order to run the models. In most cases requirements in terms of data and computer hardware to run the models are described. Hence the book may be of interest to someone wanting to adopt an existing crop–water–simulation model either for management use or for further research. Most of the models are also described in technical detail so the book could also be used as a source of ideas, or particular equations, for incorporating into other models.

The models included are: RELREG, RENANA, SCHED, BidriCo 2, SOWABAMO, MUST, SWATRE, SOYGRO, CERES-Millet, SWARD, Opus, CADSM, PROREG, IRRICEP, OMIS, HYDRADSS, and two unnamed models. Several other models are also referred to by name in the text. The book would therefore provide a useful lead into the literature, and information about the approaches being taken by many of the research groups working in this field.

The models themselves are described clearly but, other than a two page foreword, there is no overview of what the different models represent, which limits the book's usefulness to someone who is not already familiar with the general ideas and potentialities of modelling.

J. TOWNEND

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Designer Food – Mutant Harvest or Breadbasket of the World? by G. E. PENCE. 235 pp. Lanham, USA: Rowman & Littlefield Publishers, Inc. (2002). \$26.95 US (hardback). ISBN 0 7425 0839 0.

As though the subject of GM foods required more headline-grabbing publicity, this text confronts with the emotive 'mutant harvest' in the title. Is this a serious scientific subject? Undoubtedly. Is this a scientific text? No. Instead, the author has produced a philosophical treatment of the GM food debate including organic food, world hunger, agricultural terrorists, the safety of meat, environmental ethics, mad cow disease and European versus American attitudes towards food.

Essentially, the author moves through a broad range of GM food-related issues explaining the philosophies of naturalists, progressives, egalitarians and globalists. While the author makes no secret of

his pro-GM views throughout the chapters, the philosophical positions are all outlined in a rational, discursive style.

The text launches into the GM debate with coverage of organic versus GM food. This introduction exposes the myth that organic food is risk free. In addition, the significance of food as a cultural and political symbol is described. The reader begins to appreciate the complexities of this debate. Indeed, this theme is developed as four contrasting perspectives on food. Forceful arguments are cleverly laid out using a broad range of citations from popular press articles. The author concludes that 'good science can work for a better, more just world'. Furthermore, most issues in ethics are complex, so simplistic world views are unhelpful.

The mid sections of this text deal with the 1990s food scare traumas: BSE, CJD and their impact upon European societies. This provides a very useful benchmark for assessing risk as the author moves to discuss the safety of GM food. Examples include Bt maize, the use of bovine somatostatin (BST) or bovine growth hormone (BSH), Flavr Savr tomatoes, GM potatoes and other crops.

The foregoing product examples provide substance upon which a series of ethical schools of thought can be assessed. Accordingly, the scope of moral theory, deep ecology, eastern mysticism, radical environmental theory and fascism are all explored in the context of food. The author is unapologetic in his criticism of elite organizations who place the preservation of plants above feeding millions of starving humans. He concludes that not all human interests must be sacrificed at the 'alter of the environment'.

In the concluding section, the author returns to the concept of food, its value as a commodity beyond nutrition. He robustly defends the contribution of the Green Revolution and criticizes those who attempted to counter its progress in the 1970s. Modern day GM crops he concludes are simply tools which can be used for many different purposes. No single approach to addressing the world's food needs is appropriate.

Finally, the author discusses the environmental impact of GM crops via a series of case studies including Bt pollen and the Monarch butterfly, gene introgression and terminator genes. This is perhaps the most technically disappointing section of the text and serves as a reminder that a comprehensive understanding of all these issues from one author is probably impossible.

In conclusion, this text is essentially a philosophical treatment of the scientific practice of GM foods. It is devoid of any illustrations, but contains useful literature citations. This is a meaningful synthesis of the opinions and views surrounding GM food and crop issues. The book provides for students, academics and the public, a thoughtful and practical

exposé of one of the most controversial topics in current affairs.

G. MARSHALL

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Global Rangelands: Progress and Prospects, edited by A. C. GRICE & K. C. HODGKINSON. 299 pp. Wallingford: CABI Publishing in association with Centre for International Forestry Research (CIFOR) (2002). £65.00/US\$120.00 (hardback). ISBN 00 85199 523 3.

Books which contain the papers presented at conferences or congresses often appear a few years after the conferences were held and can easily appear to be out of date. This book, which sprang from the VI International Rangeland Congress (IRC) is published 3 years after the congress was held in Australia; however, it discussed issues which are still at the forefront for those involved in the science and practice of rangeland management today. Rangelands occupy over one-third of the world's land area, and directly support nearly 30% of the world's human population. Rangelands are characterized by low precipitation and high spatial and temporal distribution of that rainfall. This makes them mainly suitable for livestock production in terms of agricultural output.

Whereas, in the past, IRCs have been dominated by technical aspects of rangeland management, for example what grazing systems and stocking densities should be used to achieve optimum animal production, the emphasis of the IRC in Australia was the sustainable management of rangeland ecosystems. This is reflected in the book which contains 22 chapters which demonstrate the growing consensus that future rangeland management requires an understanding of the socio-economic and environmental consequences of management systems, not purely the animal output. In the first chapter of the book, the editors report that rangeland science has four growing themes, i.e. that rangelands are used for multiple objectives, not just pastoral use; that there is a requirement to maintain the basic resources (soil, plants, water, biodiversity, cultures) upon which rangelands uses depend; that socio-economic processes are fundamental determinants of rangeland resource use and management; and finally that rangelands do not exist in isolation from non-rangeland systems (e.g. tourism, water). The following chapters do an excellent job of picking up on these themes to provide a well-rounded and thought-provoking vision for the future of rangelands and rangeland science. One thing is clear, if the authors of these chapters are correct, in the past, reductionist

agricultural science has not done much to improve rangeland management or the livelihoods of rangeland inhabitants and it is unlikely to do so in the future. A couple of issues are important to raise, first of the 47 authors in this book, 31 are from Australia, which although it has large areas of rangelands itself, does give the book a rather antipodean bias in its examples and perspectives. Second, despite the call for community involvement in determining the agenda for rangeland research in the future, only one paper, by Joe Kotsokoane, represents first-hand the views of a representative of indigenous rangeland inhabitants.

I would suggest, that anyone interested in rangelands, be they practitioners or researchers, should read this book, not necessarily from start to finish, but at least the first and last chapters.

I. J. GORDON

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Cassava Biology, Production and Utilization, edited by R. J. HILLOCKS, J. M. THRESH & A. C. BELLOTTI. 352 pp. Wallingford: CABI Publishing (2001). £75.00 (US\$140.00) (hardback). ISBN 0 85199 524 1.

This is a conventional book that satisfies the requirement for a readable and comprehensive text on cassava and achieves very much of what it claims in the title. The book is organized into five parts and 15 chapters. The first part (origin, distribution and economic importance) reviews the origins and taxonomy of cassava and its current distributions in South America and the Caribbean, Africa, Asia and the Pacific. The second part (botany, crop physiology and agronomy), covers botany and physiology, agronomy and cropping systems and mineral nutrition and fertilization. Part three (genetics and improvement) looks at breeding, genetic resources and conservation and biotechnology, Part four (crop protection) considers arthropods, viruses and bacterial, fungal and nematode diseases and Part five (crop utilization) assesses utilization for storage and small-scale processing and utilization for food, feed and industry.

As the authors state, cassava is alone amongst the major crops of the world that lacks an authoritative monograph that covers all the areas where it is grown. The global research and breeding mandate for the crop is shared between two international centres (CIAT in Colombia and IITA in Nigeria) and six of the 20 authors in this edited volume have affiliations with these two institutions. The remainder span addresses in Europe, Asia, South America and the

USA and in this regard the work is a multinational as well as a multidisciplinary effort. As a text for researchers, extensionists and students of tropical agriculture the book fulfils a useful purpose and will, no doubt, be essential reading for any individual or institution with more than a passing interest in the species. To this extent, the book summarizes the (limited) state of our knowledge on this important but underutilized crop. There is a case for such a book which essentially allows knowledge on cassava to 'catch up' with similar 'state of the art' reviews of other major agricultural species. Where this and similar books fail is in their vision of what needs to be done in the future for research and promotion of the species and its products. The evidence for cassava as a crop for poverty alleviation and food security is best demonstrated in the chapter on biotechnology (Fregene and Puonti-Kaerlas). However, this analysis is rather lost amongst the descriptive state of knowledge on the crop reported in many of the other chapters. As a reader and, particularly, as a potential sponsor, it would have been useful if not essential to have an authoritative assessment of the future food potential, consumer demand and policy implications for further work on cassava. A comprehensive analysis of this type would be of enormous benefit in identifying not only the future research objectives for cassava but also of many other under-researched species grown predominantly by poor people. If the opportunity for a seminal work on cassava had been used to identify a clear strategy and timetable for research priorities, the value of the book would have been substantially increased both for the researcher and for the benefit of the 80% of the world's population in whose countries it is grown.

S. N. AZAM-ALI

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Methods in Agricultural Chemical Analysis, A Practical Handbook, by N. T. FAITHFULL. xxii + 266 pp.
Wallingford: CABI Publishing. £60.00 (hardback).
ISBN 0 85199 608 6.

I was willing to review this handbook because practical books appear rather seldom. At one time government agencies were the main source of this material but that function seems now in the past. The AOAC Official Methods of Analysis (17th edition) has

become the main source for such methodology but it is expensive and not aimed at teaching the skills and logistics of investigative analytical chemistry applied to agricultural materials. Authors have to be brave in attempting to tackle and condense the complex web of different techniques applied to such a diverse group of materials as soil, compost, fertilizers, plant tissue, forage, cereals, seeds, fruits, roots and vegetables etc. Instrumental and automated methods as well as biochemical kits have added to the complexity of the subject. While Pearson's has taken care of reviewing food testing methodology, nothing similar has been done recently for soil, compost, forage and feed since the MAFF/ADAS Reference Book No 427 (HMSO, 1986). So Nigel Faithfull's contribution attempts to fill this gap with a hint that another contribution on ruminant feed may be in the offing.

The first four chapters cover experimental planning, sample preparation, weighing and dispensing, acid-digest, ashing and extraction procedures. Chapter 5 details 15 methods for soil and compost analysis while chapter 6 details NPK tests for fertilizers and liming materials. Animal feed and plant analyses follow chapter 7 and silage analysis in chapter 8. A review of near-infrared spectroscopy follows in chapter 9. Methods in equine nutrition, rather strangely, occupy chapter 10 while chapter 11 applies to peculiar methods for organic farming. Finally chapter 12 treats lab QA and QC. A very useful listing of 306 key references follows. Ten appendices on selected topics take up the last 50 pages of the book before the subject and commercial indexes. With the advent of the world wide web the book cites many useful web sites which we hope may remain on the web and do not vanish into the 'ether'.

The book does a good job on various forms of NPK, major minerals and what used to be called 'proximates' in forage and feed but it does shy away from a full treatment of ruminant feeds which, according to the preface, may appear in a future book. All of the first four chapters are excellent for training as is the last chapter on quality control – I felt this should have appeared near the start of the book. The methods chapters are a very useful compilation, rich in detail and sources. The chapter on NIR seems too shallow an overview to be very useful. The chapters on horse nutrition and organic produce are unique sources on these topics. Some appendices may have fit better into the methods section.

Overall I find the book useful and good value as a practical manual.

I. MURRAY