The Long-Awaited Sourcebook Arrives

Matrix Population Models. 2nd edition. Caswell, H. 2001. Sinauer Associates, Sunderland, MA. 622 pp. $64.95. ISBN 0–87893–096–5.

The first edition of Hal Caswell's *Matrix Population Models* served as an invaluable sourcebook for population ecologists and conservation biologists for more than a decade. Indeed, the rapid growth of careful, quantitative studies of the dynamics and viability of age- and size-structured populations would not have been possible without Caswell's comprehensive guide to demographic methods. Since its publication, many ecologists have learned and applied the methods in Caswell's book and have used them in innovative ways. Theoreticians also have brought some heavy mathematical artillery to bear on vexing problems with matrix analyses. Given this explosion of interest, the second edition of *Matrix Population Models* is a welcome new reference, providing an up-to-date review of methods, as well as many new and unpublished analysis techniques, for demographers.

At over twice the length of the first edition, Caswell's book is now a huge compendium of lore on matrix models. Nothing has been removed, and a great deal has been added. Several topics that were treated more briefly before have now become full chapters (e.g., "Parameter Estimation," "Periodic Environments," and "Environmental Stochasticity"), and two entirely new chapters have been added, "Demographic Stochasticity" and "Conservation and Management." More detail and new methods have also been added to nearly every section of every chapter. Finally, the author has included pieces of MATLAB code for many of the methods he describes, giving readers a key resource for implementation of many of the newer or more complex analyses.

This lengthening and deepening of Caswell's treatment has both costs and benefits. The benefits are clear. If you already know the basics—or more than the basics—of matrix models, this book is an essential guide for what to learn next, what has just been done, and what problems are still unsolved. I strongly agree with Caswell that, especially in conservation, too many demographic analyses are performed using canned programs, with authors twisting important aspects of species biology to fit the available programs and not fully understanding the exact methods they are using or results they obtain. Plowing through this book will cure these ills, and the new MATLAB code will make it easier for a novice to construct and analyze a model tailored to his or her species. (But beware the numerous typos in the MATLAB routines that must have slipped in during typesetting. In particular, inconsistent capitalization must be fixed in many).

There is, however, an important caveat emptor for potential readers of this new, larger edition. No book can be all things to all people. Although the writing is clearer and the use of figures much improved, in most places the style is that of a theoretician writing about math for mathematicians, rich in symbols and poor in intuitive explanations. If you are an empiricist looking for a friendly introduction to demographic models, I fear you will lose heart before getting to the most useful parts of this book. The addition of so much new material also means that the reader must digest a lot of recent, often more esoteric, material before gaining an understanding of the most common and useful results and methods. I don't fault Caswell for this approach—perhaps it is necessary to pack in so much interesting material—but it does make the book much easier to digest for someone already savvy about modeling methods than for an empiricist or student wanting to learn about these methods from scratch.

Of the major additions to the book, I found the most useful and interesting chapter to be "Statistical Inference." This chapter includes many new methods and excellent explanations of some approaches (e.g., bootstrapping) that are widely useful. The "Demographic Stochasticity" chapter is intriguing: much of this is truly new material, with Caswell presenting a range of possible analysis methods for ecologists to try. The "Parameter Estimation" chapter presents a variety of ways to make parameter estimates from odd or difficult types of data. Unfortunately, it doesn't correct the lack in the first edition of a clear explanation of practical ways to take pretty good (or at least straightforward) data sets and turn them into matrix models. My experience from working with different biologists and species, including lots of cases where good data were collected specifically to make a matrix model, is that this is the major stumbling block in many applications of matrix models. Some very serious problems of data analysis and parameter estimation for conservation applications (e.g., how to estimate or model correlated vital rates or rare catastrophes) are only fleetingly touched upon. These shortcomings reflect the general emphasis of the book. Although the subtitle is *Construction, Analysis, and Interpretation*, the focus is really on the latter two topics and especially on analytical methods of analysis, with little or no discussion of many useful and often necessary simulation methods.

Conservation biologists may expect to be most interested in the new, pen-

Conservation Biology, Pages 1825–1828
Volume 15, No. 6, December 2001

ultimate chapter of the book, "Conservation and Management." But this section presents few new methods and in my opinion does not provide a good framework for the use of matrix models in conservation. Caswell's classification of how models can be used—assessment, diagnosis, prescription, and prognosis—tries to separate questions and approaches that are highly intertwined. He also devotes much of the conservation section (12 of 39 pages) to rebutting critiques of particular modeling methods (especially elasticity analysis) or of population viability analysis (PVA) in general. This is somewhat self-defeating: all the papers with which Caswell disagrees in this section were written by advocates of matrix models and PVA (myself included), who seek, as he does, to improve the understanding and discourage the misuse of matrix models. He also uses his classification of "retrospective" and "prospective" analyses (which, as he defines them, do not make sense to me) to insist that although data on mean vital rates can be used to infer future patterns and management possibilities, data on variability cannot. ("Data on how the rates actually vary (or varied) contribute nothing to prospective calculations" [p. 616].) This viewpoint is dangerous because one should never ignore information and because it obscures the differences between spatial and temporal variability and implicitly suggests that data on variability must be used foolishly, in contrast to Caswell's rightful insistence that data and analyses on mean rates (such as elasticities) must be used with care and knowledge. Overall, although the entire book is of great utility to conservation biology, I didn't find this section to be a good synthesis of the role of matrix models in conservation or how to improve their use.

In sum, I highly recommend Caswell's second edition to anyone who wants an up-to-date presentation of the many facets of demographic modeling. Although I don't agree with some of the stances that Caswell takes, especially with regard to conservation applications, the book's greatest strength is that one person wrote it and wrote it well. The unified style, viewpoint, and ideas make this book a far more useful resource than any edited volume could be. Although it is not a good beginners guide, anyone who has more than a passing interest in demography and population viability will eventually want to seek out the ideas and explanations found here.

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Biodiversity Technology in the Classroom

Conserving Earth's Biodiversity. Wilson, E. O., and D. L. Perlman. 1999. CD-ROM for Windows and MacOS with User's Guide. $39.95. ISBN 1–55963–773–0. CD-ROM with User's Guide and Instructor's Manual. $39.95. ISBN 1–55963–774–9.

When I attended the presentation by E. O. Wilson and Dan L. Perlman of their CD-ROM *Conserving Earth's Biodiversity*, I immediately grasped its utility for my teaching situation. At the time, I was teaching environmental studies to undergraduates and wanted the students to learn conservation biology basics. Few of them had a serious interest in science, but all had an interest in protecting the environment. I intended to use the CD as bait to get them to bite the hook that would reel them into science. For the most part, this approach worked. Although there are still problems with applying technology in the classroom (e.g., hardware availability, teacher interest, student sophistication, and overexposure to technology), Wilson and Perlman's CD is a valuable introductory teaching tool. Compared to a printed text, it allows experimentation with mathematical models, and it has a pleasing environment, flexible graphics, and other benefits of software graphic interfaces. And, just like a text, it requires considerable teacher preparation.

The CD-ROM has eight major sections, focusing on global patterns of biodiversity, evolution, anthropogenic effects, conservation practice, and the social and economic context in which destruction and conservation occur. There are 15 world maps that can be compared side by side, illustrating aspects of global resource consumption. Video introductions can be skipped over by the literate, yet provide an easy learning opportunity for novices. Also, there are hundreds of web links to pre-screened sites and embedded study questions, although these may reach too far and teachers will probably want to create their own. Case studies, such as a description of contracts for ecosystem services in Costa Rica, are a break from explanatory text. Interactive programs on human population growth, deforestation rates, island biogeography, and demographic stochasticity allow students to manipulate variables. The virtual environment has recordings of tropical bird songs, background photos, and clearly stated options. Some of the introductory essays have introductory paragraphs that are too long. The instructor's manual is useful, although if you are an experienced teacher, experimentation will get you to the same place.

The philosophical underpinning of the CD is to "give students control over their own learning." Without rigorous preparation and guidance by the instructor, students will do what they (we) always do: peruse it lightly and forget about it. In fact, in a mixed course of graduate and undergraduate students I gave students the option of using the CD; only one did so. In other words, interactive technology should not be considered a shortcut around preparation. The manual suggests running through preselected sections in class and integrating the embedded study