A new framework for teaching ecology

Ecology in Action by Fred D. Singer (author), 2016, Cambridge University Press, 675 pp. £44.99 (Hardback) ISBN 9781107115378; http://www.cambridge.org/ecologyinaction

Ecology in Action by Fred Singer is the first ecology textbook to be written with explicit consideration of the growing use of open-source statistical software in scientific research, and has the potential to change how we teach entry-level ecology. The author has made a concerted effort to inform students what 'doing ecology' actually requires, from the perspective of real ecologists. The result is an engaging volume with an underlying theme that is as much one of fostering scientific curiosity as it is of bestowing information. The book is aimed at undergraduate students with introductory biology and chemistry knowledge. However, I would add that (as in any ecology course) students would also benefit from at least a basic knowledge of calculus to help them understand the ubiquitous models of population growth and competition that are built using differential equations.

The material moves through twenty-four chapters, comprising five main parts that are organised by levels of ecological hierarchy: physical–chemical, organismal, population, community and ecosystem. Each chapter ends with the standard offerings of further readings and end-of-chapter review questions. The lists of additional readings contain a good mix of classical and cutting-edge research, a welcome divergence from the habit of asking students to slog through primary literature that has been gathering dust since before they were born. Readings are also accompanied by succinct descriptions, including warnings of particularly dense articles that should be welcomed by those students who are inclined to access the extra material.

The final chapters in each of Parts II–V focus on the work of particular scientist, all of whom are still active in ecology at the writing of this review, and whose research epitomises the major theme of the particular book section. A distinctly positive note is the gender representation achieved among the individuals selected for discussion, though the absence of any ecologist of colour is unfortunate. The inclusion of scientists' biographical information and personal anecdotes along with summaries of their research, themselves written in a highly accessible, narrative style, simply makes this particular textbook more interesting than others.

The accessibility of the palette used for figures, captions and key words may be an issue for some users (Jenny & Kelson 2007). I applied a colourblindness filter (Color Oracle v 1.1.4) to the digital chapters available on the publisher's website and found that the shade of green used for figure captions and in-text references to figures was indistinguishable from the orange used for in-text keywords. The two-category bar plots and some of the line plots are also shaded in red and green, which is perhaps the least-accessible combination of colours when patterns are not used in concert to differentiate among factors. In addition, even the simplest bar plots are shaded using a gradient for no apparent reason.

A highlight of this volume is the included *R companion*, a digital manual written by by Edd Hammill, which provides lessons in using R for data analysis, closely following the material in the main text. Better manuals on introductory R (e.g. Beckerman & Petchey 2012) as well as more advanced volumes on R-based statistics (e.g. Field et al. 2012) are already available. However, integration of an R manual into basic coursework is well overdue in ecology. While going through it, I found myself excitedly re-imagining the material for a semester's-worth of quantitative ecology labs.

The *R Companion* is not quite sure whether it's an R manual or a statistics manual. If the former, it is missing key elements that differentiate R from other statistics programmes and that would allow students to achieve true competence as users. If the latter, its usefulness in a classroom setting may depend on whether a particular degree programme requires introductory statistics as a prerequisite to ecology, because the statistical tests included should have been covered in another course.

The *R companion* would have benefitted from some additional research and editing, as the writing deviates from correct S-language terminology as well as general computing terminology, with confusion around use of the terms 'script,' 'command,' 'list,' 'program' and 'open' (Venables et al. 2016), among others. As computer science is becoming increasingly taught in primary and secondary schools, future students will be entering university with a much higher level of computer science knowledge and will notice such discrepancies. To avoid confusion, the current version of the *R companion* should be taught by someone with substantial experience in R, as well as some knowledge of the basics of coding outside of R.

A final thought: *Ecology in Action* stands on its own as an excellent textbook for teaching introductory ecology and is a good first effort at integrating the standard academic volume with open-source statistical software. The *R Companion* doesn't quite hit the mark, but errors should be relatively simple to correct in subsequent versions. Future iterations can only get better.

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