BOOK REVIEWS

Applied Population Ecology: A Supply-Demand Approach. Andrew Paul Gutierrez. 1996. John Wiley & Sons, Inc., New York, NY. 300 p. $69.95 hardcover.

The overall goal of this book is to bridge the gap between the theory and application of population-based ecological models. Gutierrez indicates in the preface that the text originated from notes he developed for a lecture in insect ecology. His purpose here was "to provide an entree for students of applied ecology whose forte is not mathematics to the increasingly difficult literature in population ecology" and to "stimulate field ecologists to expand their use of basic mathematics to evaluate the literature with a more discerning eye, and help them to solve more efficiently real world problems..." As a field ecologist with a reasonably strong background in mathematics and a passing interest in modeling, I felt that the efficacy of the text would be well tested by my reading. In many respects, the objectives of the text were met.

The 300-page book is organized into 12 chapters with approximately 85 pages of appendices and 35 pages of literature and indices. The remaining 180 pages are by no means light reading for late evenings by the fireside. This text does not present a broad overview of the discipline or review of the literature—it is for those who are seriously committed to understanding the basic mathematics of population modeling. I had to labor for some time in areas of the text that were heavy with differential equations or complex mathematics in order to follow the text. Fortunately, the editing was of high quality and in very few circumstances did I discover any typographical errors in formulae. I was pleased that the author included intermediate formulae in most of his derivations and appendices to help with more complex issues.

Chapter 1 provides a brief introduction to the text, outlines some basic ecological concepts, and sets the stage for the rest of the text. Arguing that all species are faced with similar problems of resource acquisition and allocation, he uses this as the basis from which to build his models. Chapter 2 considers how to sample populations, not in a "how-to" context, but rather in the context of what is required for biologically meaningful data (e.g., issues of accuracy and precision). As a field biologist I would have liked to have seen more information in this chapter. The upshot being that considerably more data are required to verify a model than to formulate it. Chapter 3 lays out the classic debate of biotic vs. abiotic population control. Gutierrez emphasizes the role of temperature and nutrients as the major rate limiting factors in poikilotherm development and the need to consider these factors in modeling. Chapter 4 reviews the basic concepts of laboratory age-specific life tables, aspects of survival and fecundity, resampling statistics (jackknife, bootstrap), and the need to bring temperature and nutrients (tie-in to Chapter 3) into time-varying life tables. Chapter 5 reviews basic predator-prey dynamics, the basic functional response models, and aspects of estimating prey preference. The first five chapters present mostly review concepts of basic ecological theory, examples from the literature, and the mathematics behind the models.

Chapters 6 to 10 present what I would consider to be the core of what Gutierrez wishes to communicate. In Chapter 6 he lays the foundation for the development of a physiologically based age-structured multitrophic population dynamics model. He argues that the best approach to modeling energy in a system is not through classical flow dynamics, but rather via an analysis of per capita energy partitioning. This is followed in Chapter 7 by a review of the Lotka-Volterra models and an examination of various studies, including his own, that have reanalyzed Nicholson's classic laboratory studies of blowfly dynamics. Chapter 8 introduces the notion of food web analysis and the various limitations affecting model development in this area. Age structure and mass are added to the basic metabolic pool analysis of the blowfly data in Chapter 9 and "represents the major progress reported here." The modeling section is essentially closed in Chapter 10 with an examination of the cotton-boll weevil system and discussion of how this model can be used to understand the ecological basis of evolutionary change in biomass allocation patterns. The remaining two chapters (11 and 12) seemed a bit contrived and awkward. The author wished to close with some general remarks about the applicability of population modeling brought to a larger scale. He discusses the role of modeling in a regional or landscape context employing satellite data and GIS and the need to think about global sustainability, the caveat being that the application of these models at this scale still suffers from some intractabilities.

Overall, I give the text high marks for approach and presentation. The book has end-of-chapter appendices where deemed necessary and a large appendix reviewing the necessary mathematics required for biologists to understand basic models. The text is well written, well edited, covers the basic theoretical references, and contains useful epilogues for reflection at the end of each chapter. On the down side, this text will probably not find a place on every population biologist's bookshelf. The focus is rather narrow, the approach fairly specific, the examples largely entomological (but often multitrophic), and will likely be intimidating to those without a mathematical bent. I certainly recommend it as a useful addition to all research libraries and to individuals wishing an entry point into modeling population dynamics and multitrophic interactions.

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The Simple Science of Flight: From Insects to Jumbo Jets, 2nd Edition. Henk Tennekes. 1996. The MIT Press, Cambridge, MA. 137 p. $20.00.

Never before has a book appeared that so effectively incorporates the flight of insects and birds with the fleet of modern day jumbo jets. Henk Tennekes's book is a clever combination of science and artistry.

Originally published in the Netherlands, the book exemplifies the line which appears before the Table of Contents, "A bird flies according to mathematical principles."...Leonardo da Vinci, 1505.

Tennekes is a master of combining the objective world of physics with the subjective arena of nature and artistry. Because he believes physicists and engineers have a habit of frightening many readers by using harsh-looking formulas to calculate size, speed, and energy, he beautifully cloaks his formulas in the soft veil of the beauty of creation and artfully teaches by association.

While illustrations are abundant and clearly drawn, and tables well-illustrated and interesting, one can only contemplate the beauty of the book had it been done in color.

Tennekes uses a simple act first tried as children—holding one's hand out of the window of a moving car—to effectively explain aerodynamic lift. With Vance Tucker's wind tunnel for birds, he compares their flight with that of airplanes in wind tunnels. Additionally, he divides birds by their wing shape categories: wings with high and low wing loading—just as airplanes are classified. Then, he compares the two types. Flapping wings of birds are likened to ice skating strokes with the plane-of-action rotated 90 degrees.

Tennekes's chapter on flying playthings covers a flight scale from paper planes and two-string kites through a progression of parachutes and ultralights, and terminates with 747s.

A favorite insight for flight instructors would be the episode of a mature herring gull teaching his fledgling son step by step all that is involved in landing with this description: Start your descent at a speed that allows you to cope with wind gusts, monitor your descent with reference to your landing site, extend your legs a little if you are not descending fast enough, reduce your speed within the last few seconds of the approach by leaning back and keeping your nose high. The likeness to landing a plane is astounding.

Tennekes seems to spend more time explaining birds than planes; however, he is able to explain much about airplane performance with this innovative technique.

There remains a possibility that engineers may not appreciate this aesthetic approach to a technical field; however, students and women, in particular, will most assuredly welcome it.

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Polygyny and Sexual Selection in Red-winged Blackbirds. William A. Searcy and Ken Yasukawa. 1995. Princeton University Press, Princeton, NJ. 312 p. $29.95 paper.

The red-winged blackbird (*Agelaius phoeniceus*) is the most abundant bird in North America, nesting from the Florida Keys to the Pacific Coast and up to the boreal forest regions of Canada. I first began compiling literature on this remarkable species in 1972, upon arriving in Ohio to conduct research on ways to reduce blackbird damage to agricultural (grain) crops. At that time, the literature on nesting and reproduction in redwings was fairly limited, with only about a dozen good studies to scrutinize. I quickly mastered the literature. However, that was soon to change. Starting in the late 1970s, a virtual avalanche of papers on redwing reproduction and nesting behavior by an outstanding cadre of young scientists (including the authors of this book) descended upon the ornithological and behavioral journals. Quickly buried by this onslaught, I have been trying ever since, unsuccessfully, to dig my way back to a mastery of the literature on redwing reproduction. William Searcy and Ken Yasukawa have mercifully pulled me (and I am sure a number of other grateful ornithologists and evolutionists) to the surface by writing this masterful book which organizes, critically reviews, and interprets the myriad findings of the past 20 years. The book contains over 400 literature citations, 43 of research by the authors.

Redwings have been a tempting subject for the study of evolution and adaptation in avian reproduction because of the fortuitous combination of their abundance, visibility, accessibility, geographic variability, and especially, polygynous mating system. Polygyny is an uncommon (for birds) mating system in which individual males establish territories where often more than one female nests. Because the overall sex ratio of the population is balanced, this means some males do not hold territories (floaters) and others hold bachelor territories. Why is this so? What attributes do the study males who attract all the females have over those poor males who 'strike out'? Why would a female settle on a territory already occupied by several females and have to share limited resources when many other nearby territories go begging? A 'wild card' in this system that adds pizzazz to the puzzle is the recent findings, from DNA studies, that perhaps 25% of the eggs in a territory are fertilized by some other male. Perhaps those poor redwing 'bachelors' and 'floaters' are smarter (more evolutionarily fit) than we realize! These are the issues addressed in this book.

The book, after an introductory chapter, is organized into two sections covered in eight chapters followed by a final chapter summarizing the authors' conclusions on polygyny. The first section deals with the evolution of polygyny in redwings. The strength of this section is that the authors do an excellent job of laying out a logical sequence or hierarchy of hypotheses (models) regarding polygyny. These hypotheses, regarding the costs and benefits of polygyny to females (essentially, why share a male with other females when you can have one all to yourself?), are then tested against findings from the available literature. A refreshing feature of this section is that the authors are not afraid to lay out studies with contradictory findings side by side and admit that, in spite of all that is known, there is still much confusion. Answers to complex evolutionary questions will never come easy or be complete. Nature is too mysteriously wonderful for that to happen. For example, the prevailing literature suggests that established females do not prevent, through aggression, additional females from nesting on a territory. However, one study, by

Hurly and Robertson (1984), was contradictory, indicating females (in an effort to minimize the cost of polygyny) do have a deterrent effect on additional settlements (p. 115). I predict additional studies will swing the tide of evidence in favor of Hurly and Robertson's findings.

The second half of the book deals with the consequences of polygyny regarding sexual selection in redwings. How does female selection of territories and the males that occupy them translate into the evolution of male characteristics such as physical size, coloration, and vocalizations? I can not help but disagree with the tentative conclusions of the authors that male attributes have little to do with which males get the best territories and most females, but rather, that chance ownership of territory is the important factor (p. 191). Evolution does not operate by a lottery system or accident of ownership. Again, future studies will clarify this important question. And in addressing this question, one should always remember those 'sneaky' off-territory males that are fertilizing 25% of the eggs.

As a biologist who has spent many years studying redwings during the non-breeding season (August-March), I feel one weakness of the book is the failure to examine, at least briefly, the influence of activities such as communal roosting (sometimes by the millions), flock feeding, and migration on selection for attributes. For example, differential size, migration, roosting and foraging strategies allow the sexes to avoid competing for food during the winter. All attributes of redwings cannot be explained by selective forces operating only during the three to four month nesting season. A more holistic approach is needed.

In conclusion, the authors have done an excellent job of synthesizing the literature on the breeding biology of one of the world's most abundant, interesting, and beautiful birds. The book should be read by anyone interested in the evolution of vertebrate mating systems. I particularly recommend the book for advanced students considering research careers as field biologists. Paths leading to an understanding of the evolutionary forces that shape the natural world are difficult to follow. Ingenious experiments, often requiring tremendous patience and endurance, must be conducted. Occasional dead-end roads must be traveled and retraced. But slowly, using the light of the scientific method as a guide, a path is successfully navigated and secrets of the natural world are unveiled. This book provides a good model of that exciting journey that scientists are privileged to take.

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