BOOKS: ECOLOGY

Understanding the Dynamics of Populations

Nils Chr. Stenseth

The study of the dynamics of populations is essentially a quantitative, statistics- and mathematics-based enterprise. A major challenge facing population ecologists is the development of appropriate theoretical (mathematical) models for improving our understanding of the dynamics of particular populations. The processes of obtaining data and linking these to the theoretical model require statistical analysis and inference. Mathematical analyses are needed again when such empirically based models are applied either for theoretical purposes or for aiding management decisions.

Analysis and Management of Animal Populations
Modeling, Estimation, and Decision Making
by Byron K. Williams, James D. Nichols, and Michael J. Conroy
Academic Press, San Diego, 2002. 835 pp. $99.95, £69. ISBN 0-12-754406-2.

Analysis and Management of Animal Populations is, almost, the book ecologists have long sought to help them find their way around in the huge and rather technical literature on population ecology. Students will find the volume a gold mine; the book effectively covers a range of methods they may—and really ought to—need in their own studies. Professional ecologists will find a solid reference book within which to look up things. And managers and conservation biologists will find a book in which they can learn what the theoretical platform for management of wildlife populations ought to be.

Byron Williams, James Nichols, and Michaël Conroy provide chapters on the scientific process as applied to population ecology and hypothesis testing, on the design and analysis of surveys, and on experimental design and the analysis of such data—topics commonly covered by statisticians. Also included are chapters on dynamical modeling of populations, both deterministic and stochastic models—topics typically treated by theoretical ecologists of one blend or another. There are chapters on estimation methods for populations, which discuss abundance, density, and vital parameters such as survival rates. Many of these chapters focus on the analysis of mark and recapture data, a field that has recently flourished because much valuable data has been accumulated and because of recent major theoretical developments. The last section of the text contains chapters on using decision theory for the management of populations; the authors' discussions pay proper attention to uncertainties inherent in such enterprises. In addition, a series of appendices provides background material on such topics as Bayes' Theorem, matrix algebra, probability distributions, and the mathematics of optimization. The book is also full of good tutorial guidance and advice.

The three authors have—individually and collectively—an ideal background for writing such a comprehensive book. Through their positions with the U.S. Geological Survey's Biological Resources Division, they have dealt with a broad suite of wildlife management issues. And each of them is active and experienced in the three thematic areas covered by the book (modeling, estimation, and decision theory).

Given the wide range of material covered, one might say that the volume contains too much, but it really does not. The authors offer a well-integrated account. Altogether the book also demonstrates that population ecology is a united—and, one might add, mature—scientific field. But *Analysis and Management*—with its 835 large pages—is not something you would put in your luggage unless absolutely necessary.

Despite its detailed and wide-ranging discussions, the book lacks an important element of population modeling, the analysis of time series data (typically extending into the past). I am biased on this point, but I believe that today we must pay attention to this sector of population ecology. Unfortunately, the authors do not provide any indication as to why they omitted discussions of time series modeling. The absence is clearly not due to the authors being unaware of the relevant literature (and tool box): they refer to studies using such methods. My guess is that they chose not to discuss time series analysis because we often do not know in detail how the data were obtained and, hence, do not adequately know the sampling variance and covariances. Indeed, many ecological time series analysts provide little ground for believing that they have even thought about the underlying sampling model.

Nevertheless, two recent developments have profoundly sharpened time series models in ecology: One is the formulation of time series models in terms of the parameters of the assumed underlying dynamic system (a development which the authors briefly mention). The other is the application of so-called state-space models, which incorporate an underlying theoretical model and an observation model (that accounts for how the data were obtained) and which link the observations to the quantities of the assumed ecological model. Many problems remain; for instance, conclusions from analyses may be clouded by sampling variation and covariation. Time series models of, for example, count data provide inferences about the product of detection probability and the quantity of interest (e.g., abundance). Thus, in the absence of information

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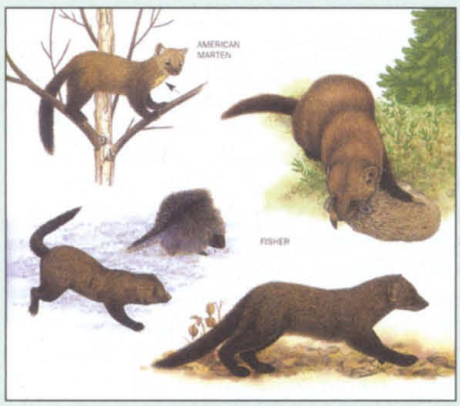

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Mammals of North America. *Roland W. Kays and Don E. Wilson.* Princeton University Press, Princeton, NJ, 2002. 284 pp. $49.50, £35. ISBN 0-691-08890-X. Paper, $19.95, £13.95. ISBN 0-691-07012-1. Princeton Field Guides.
This book will be welcomed by amateur naturalists and field biologists seeking to identify any of the 442 mammal species found north of Mexico. The color paintings illustrate all species and include distinctive age, sexual, seasonal, and geographic variations. Many—such as these depictions (left) of the American marten (*Martes americana*) and fisher (*M. pennanti*)—incorporate aspects of the animals' habitats. The concise text highlights characteristics crucial for identification and also mentions relevant aspects of behavior and ecology. The species accounts are accompanied by distribution maps and supplemented with depictions of tracks and scat.

about detection probabilities, it is difficult to decide whether model-based inferences apply primarily to the sampling process or the ecological process. Nonetheless, time series data offer us the only description of the long-term dynamics that we are interested in; hence, we would be foolish to not use these data (with the proper method of analysis). We should, however, encourage monitoring programs that incorporate estimation of detection probabilities so that future analyses can disentangle sampling from ecology. I only wish the authors had included more on these issues. Their writings elsewhere indicate they are certainly capable of writing a good chapter on this important topic.

In spite of my somewhat critical remarks, I found the book to be very good. What it covers, it does so excellently. Now, someone has to write the supplement, the companion book on the analysis of time series data. None of the books available on that topic are of the caliber of *Analysis and Management of Animal Populations*.

BOOKS: ASTRONOMY

The Joy of Stargazing

Robin M. Catchpole

Opening *Seeing in the Dark* reminded me of one of the unanticipated pleasures of being a professional astronomer. During nights unsuitable for serious observation, one can revert to being an amateur and use the telescope to look at pretty things. On some occasions when very thin cirrus is present, the "seeing" (sharpness of the image) can be exceptionally good. Then one can seemingly cruise above the lunar surface, looking at the ancient craters, volcanic rilles, and the long, sharp black shadows cast by mountains catching the rising sun. One of my most memorable moments from such nights occurred as I looked at the "Trapezium" (the four bright stars at the heart of the Orion nebula) while an adjacent computer displayed an image taken by the Hubble Space Telescope of the same region. With its much greater resolution, the Hubble image showed the region's newly born stars surrounded by protoplanetary disks. Knowing about these details greatly enriched the experience of looking through the telescope. Seeing is indeed believing.

Seeing in the Dark
How Backyard Stargazers Are Probing Deep Space and Guarding Earth from Interplanetary Peril
by Timothy Ferris
Simon and Schuster, New York, 2002. 399 pp. $26, C$39.50. ISBN 0-684-86579-3.

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Sadly, such days are almost past. Fewer and fewer professional telescopes have an eyepiece. If the weather is clear, it is possible to spend the whole night observing from a well-lit control room and never see either the telescope or the sky. Indeed as a new generation of robotic telescopes comes into use, the time cannot be far off when there is no need even to visit the observatory.

Science writer Timothy Ferris's book is about the glory of the night sky, what it means, and some of the people past and present who love it. Ferris reminds us just how thought-provoking and moving the night sky can be. He takes us along on his journeys around the world, meeting amateurs and professionals who share his enthusiasm. On the high Texas plains, we find Barbara Wilson perched "atop a small ladder, peering through her 20-inch Newtonian—an instrument tweaked and collimated to within an inch of its life, with eyepieces that she scrubs with Q-tips before each observing session, using a mixture of Ivory soap, isopropyl alcohol, and distilled water." She is looking for the jet of electrons emerging at nearly the speed of light from the black hole at the center of the galaxy M87, 40 million light years away. When, finally, she sees it, she exclaims, "It's there! I mean, it's *so* there!" Along with vignettes of the many characters, Ferris gives us an introduction to astronomy and guides us through the night sky, from nearby planets to stars and distant clusters of galaxies.

Eyes on the skies. Star parties draw astronomy enthusiasts to dark sites where they can enjoy the celestial splendors.

When I became an astronomer 40 years ago, I was delighted to find that professional astronomy was all about the physics of stars, everything that amateur astronomy was not. This situation has changed somewhat since then. Ferris reminds us that amateurs make an increasingly important contribution to the science of astronomy. Not just in their traditional role of sweeping the dusk and dawn skies for comets, but in searching nearby galaxies for supernovae, following variable stars for signs of unusual activity, hunting for asteroids, and even monitoring changes on the surfaces of planets. In fact, they undertake many of the time-consuming activities for which it would be impossible to schedule large, professional telescopes. Some amateurs now use charge-coupled device (CCD) detectors, making their observations more accurate and their telescopes more efficient. Others, from around the world, collaborate with professionals in the continuous observation of variable stars. This requires careful standardization of procedures as well as rapid communication.

Ferris discusses an excellent example of how amateur astronomers have contributed to astrophysics: the case of supernova SN1987A, the brightest supernova to be seen since the invention of the telescope. The official first discovery of the supernova was made in Chile by an amateur turned professional, Ian Shelton, when he developed his photographs of the Tarantula region at the end of the night on 24 February 1987. A crucial detail in unraveling the physics of the explosion was measuring the time between the collapse of the stars core (signaled by the arrival of neutrinos, which were detected in Japan at 07:35:41 UT on 23 February) and the arrival of the shock front at the star's surface (which caused it to brighten). A then-untested "neutrino cooling" theory predicted the interval should be about two hours. But who could possibly have been watching the star before it exploded? Fortunately, Albert Jones, a well-known New Zealand amateur with more than a half million variable-star observations to his credit, happened to looked at Tarantula around 09:30 UT (near the beginning of the New Zealand night) and saw nothing unusual. An hour later, Robert McNaught, an amateur in Australia, took a photograph which showed that the star was already bright. This pair of observations confirmed that the shock had indeed taken between two and three hours to reach the star's surface. It was not until 31 hours later, that the first serious professional observations were made.

Ferris has an easy-to-follow but authoritative style. The book is well referenced and includes an excellent index and glossary. A series of short appendices provide an introduction to observing techniques, basic astronomical data (on meteor showers, representative bright stars, and the planets and their satellites), a list of Messier objects (to look at with binoculars and small telescopes), and rudimentary star maps.

Despite my living under the frequently damp, gray English skies, *Seeing in the Dark* would have inspired me to buy my own small telescope—had I not recently done so.

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