Book Reviews

The Epidemiology of Rabies

Population Dynamics of Rabies in Wildlife. PHILIP J. BACON, Ed. Academic Press, New York, 1985. xviii, 358 pp., illus. $58; paper, $29.95.

Rabies is still a major problem in developing countries, resulting in 15,000 human deaths a year and an annual loss in cattle production of $250 million in Latin America alone. In Europe, the disease poses a much less severe threat (rabies was eradicated from Britain in 1903), though the stigma of madness, the horrifying symptoms, and the inevitable mortality still provide sufficient impetus for both intensive surveillance and active research. This volume is a collection of papers covering geographical, biological, and theoretical aspects of the infection.

The role of wildlife in rabies epidemiology has been slowly clarified over the last 100 years, and recently it has become apparent that attempts to control the infection by culling wild host populations are both costly and ineffective. This realization has led to the development of quantitative attempts to assess the chances of disease spread and persistence, and it is in this context that the present volume is envisaged as a case study of the practical application of mathematics in biology.

The book is extremely successful in making the point that the epidemiology of rabies varies dramatically among geographical locations, depending on the key species of wildlife involved in its transmission. The population dynamics of the infection are critically dependent on the ecology and behavior of the species involved, and thus no global generalizations are possible. Because of their medical and veterinary implications, attention has most often been focused on epidemic outbreaks, leaving information on possible endemic and persistent infections virtually nonexistent. The most extensive survey, and one that is covered in detail in the book, concerns mongoose rabies in Grenada, where a long-term surveillance campaign was begun in 1968 and has continued until the present. Data concerning mongoose population dynamics, in particular resilience to control attempts, are in good supply. Perhaps the most significant unknown (here as elsewhere) is the importance, or otherwise, of acquired immunity in the epidemiology of rabies infection.

The tendency toward temporal oscillation in rabies epidemiology, as a result of the high basic reproductive rate of the infection combined with its pathogenicity, appears to be universal and is consistent with the development of theoretical interest in the spatial characteristics of infection patterns. The second half of the book is concerned with various approaches to modeling: deterministic and stochastic, discrete and continuous, temporal and spatial. This division of the volume into two parts, one empirical and the other theoretical, is an unhappy but inevitable reflection of the difficulties involved in their integration, indicating a weakness not of this volume in particular but rather of the current state of epidemiology. The major advantages to be achieved by a marriage between mathematics and biology will require much more than the juxtaposition of otherwise disparate chapters.

In terms of rabies biology, the volume is timely (particularly for Britain, where interest in rabies control has shown a further resurgence with the advent of the channel tunnel) and serves to highlight the difficulties involved in control of established disease. The qualitative features of rabies infection have already been successfully captured by mechanistic models developed to give insight into the nature of the host-parasite population interaction. The quantitative details of each of the epidemiological parameters, however, remain to be acquired before the models can have predictive value in particular locations. The details of mammalian social behavior and their integration with theoretical ecology thus still hold the key to rabies management.

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Insect Life Histories

Seasonal Adaptations of Insects. MAURICE J. TAUBER, CATHERINE A. TAUBER, and SINZO MASAKI. Oxford University Press, New York, 1986. xvi, 411 pp. $39.95.

This book offers the first comprehensive treatment of insect life cycles since Danilevsky's landmark book published in English in 1965. It is abundantly clear that a tremendous amount of research has been lavished on various aspects of insect life histories. This volume cites over 1900 publications, most of which have appeared since 1970. The authors undertook a daunting task in setting out to organize this vast literature.

This book centers on the phenomenon of diapause. As the authors emphasize, this phenomenon, often involving reduced metabolism, slowed development, and enhanced resistance to harsh environments, underlies the three principal adaptations to seasonality in insects, namely dormancy, migration, and polyphenism (changes in morphology). Accordingly, after a discussion of the seasonal patterns to which insects have adapted, the authors treat thoroughly the sequence of events involved in the induction, maintenance, and termination of diapause. As is the case throughout the book, the leitmotif is the diversity of patterns displayed by different species and populations with respect to essentially the same phenomenon. One of the pleasures in reading this volume is the manner in which this diversity is treated. To support each point the authors provide extended examples, which read as engaging stories and are followed by extensive sets of related references. Each section concludes with a useful summary. The evolutionary problem posed by the multitude of observed patterns is how many result from phylogenetic or developmental constraints as opposed to being directly the result of selection.

The details of diapause having been summarized, the stage is set for a discussion of the evolution of insect life cycles. Again the theme is diversity as the authors consider the genetics, evolutionary origins, implications for speciation, and microevolution of seasonal life cycles. The book correctly exposes a gaping discontinuity between the observations and the theory available to explain them. Bringing data and theory together remains a challenge for theorists and experimenters alike.

Typifying the completeness of this work, a separate chapter covers the life cycles of parasitoids and social insects and of insects from tropical, arctic, and desert environments. Since insects are probably our main competitors for food, it is appropriate that the authors devote a chapter to the role of an understanding of seasonal life cycles in pest management.

I was disappointed that the authors provide no overall summary setting forth what they think we have learned about seasonal life cycles in insects and what they consider the important problems to be solved. But the great contribution of this volume is that it makes available a vast and esoteric literature to researchers, especially students, who are seeking interesting questions to investigate. Any reader familiar with the general field of life history evolution will discover in this book a gold mine of research opportunities.

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