book reviews

Animal interactions

Models in Ecology. By J. Maynard Smith. Pp. xii+146. (Cambridge: London, January 1974.) £3.70; $10.50.

ECOLOGY suffers from a surfeit of fascinating, but apparently unrelated observations, superimposed upon an acute shortage of general theories. An inevitable consequence has been the growing importance of general, precise, rather simple models which may provide insights into the workings of the real world, without its baffling complexity. This book provides a particularly good example of the approach, although it is by no means a general account of the ways in which models have been, and are being used in ecology. The problems which it chooses to examine range from predator-prey systems (chapters 2, 4, 6 and part of 11), the importance of time delays in population dynamics (chapter 3), competition (chapters 5 and 9), stability and complexity (chapters 7, 8, 10 and 11) and territorial behaviour (12), with the underlying theme throughout being the problem of stability in ecological systems. Virtually all the models are in the form of deterministic differential equations, the justification for using deterministic models being discussed briefly in chapter 1. In a comparatively small number of instances difference equations are used, while Leslie matrices are mentioned so briefly in chapter 3 that their inclusion hardly seems worthwhile.

As Maynard Smith points out, "the purpose of mathematics is to render the assumptions lying behind the arguments more explicit". But that is only the first step, albeit an important one. Conclusions derived through use of mathematics, and hence the assumptions themselves, should obviously be tested repeatedly against the real world, and even more importantly the models should suggest new insights and suggest new observations that are worth making. There are a disappointingly few places in this book where really new insights emerge, although it provides additional information and very useful summaries of a number of previously fairly well worked ideas. Material that is substantially new is to be found in chapter 6, which considers the effect of migration between sub-populations on the stability of predator-prey systems. It is a great pity that the logic used in setting up the model (pages 75–83) is not more fully explained. It seems to contain some curious assumptions, including the one that the addition of predators will make the prey in a subpopulation reach a larger population size faster than would be the case in the absence of predators. This does not seem reasonable. It is also a pity that no attempt has been made to find an analytical solution to the migration models, at least for the case of the simple model.

Chapter 10 includes a new analysis of a simple food web which attempts to provide a partial answer to the important question of how the number, and strengths, of the connections may influence the stability of the component populations. Again, an analytical solution is not attempted (and in this case one may not exist), but a simulation provides some interesting conclusions. Finally, chapter 12 provides a particularly good example of how an extremely simple model (in this case concerned with the influence of territorial behaviour on population density in birds) can provide some very interesting new insights into a well studied, but little understood, phenomenon.

In a number of other places in the book, the analysis may not be particularly new, but what it does do is explain well the main features of, or drawbacks and advantages in the types of analysis used by other workers. For example, it has some interesting comments to make about the 'standard' competition equations, and it provides an excellent summary of the major drawbacks inherent in the application of statistical mechanics to community modelling. Despite the sophistication of the mathematics, efforts in this direction would seem to be totally misdirected.

One of the main problems with the book is the patchiness with which it makes successful contact with the real world. Indeed this is partially acknowledged by the author, and by itself is not a major criticism, unless the reader (in making the contact for himself) finds a number of the models inadequate. Thus, there are rather sweeping generalisations being made about predator-prey systems in general, that are based almost entirely on models of predators which feed on only one species of prey, without questioning whether this is actually typical of most real predators. The fact that it isn't is never mentioned.

Nor are some of the actual attempts to relate observations and models equally successful. Some, like the analysis of Nicholson's blowflies in chapter 3 seem to be good, but others, like the attempts to relate the stability properties of community models to Elton's and Watt's observations seem to lose sight of the obvious point that Elton and Watt are largely talking about population fluctuations, and the models are dealing with neighbourhood stability. These are not necessarily the same thing. Until ecologists build community models which consider global stability, and until they have experimental data that show whether the fluctuations one observes in nature are really unstable, or whether they merely represent, say stable limit cycles, movements towards equilibria with long damping times and continual disturbance, or what have you, most of the elegant discussion on pages 112–5 is not relevant.

It is certainly not a book for someone without a fairly good grounding in ecology. Equally it is not particularly suitable for someone who wants to learn how to apply certain techniques. One could not, for example, find out how to go about solving the general neighbourhood stability properties of a differential equation model. What it does do is show how apparently complex ecological problems can often be approached by rather simple models, and how such models can be used to 'get the feel' of the problem. If it encourages more practicing ecologists to do this it will have served a useful purpose.

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Mathematical magnetism

An Introduction to Electromagnetic Theory. By P. C. Clemmow. Pp. xi297. (Cambridge University: London, 1973.) $10.

IN explaining his reasons for adding another text to the many which already deal with electromagnetism at undergraduate level, Dr Clemmow makes the point that competition from other topics in a widening curriculum leaves less time than formerly for a student to master the fundamentals of electromagnetism and this calls for a more crisp approach than has been usual. This idea determines both his choice of material and the manner of presentation. The material is pared down to theoretical essentials, very little being allowed in purely to illustrate or for reinforcement, while the style is disciplined and economical, making each point once only, and that in a rather austere mathematical way. Within this framework,