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Karl Gustafson
University of Colorado

The Theory of Evolution and Dynamical Systems: Mathematical Aspects of Selection. *By Josef Hofbauer and Karl Sigmund.* Cambridge University Press, Cambridge, UK, 1988. viii + 342 pp. $65.00, cloth, ISBN 0-521-35288-6; $19.95, paper, ISBN 0-521-35838-8. London Mathematical Society Student Texts, Vol. 7.

When asked to review this book, I had to search deeply to see if I could be unbiased because of fond recollections about some criminal escapades of the first author. In 1986, when Dr. Hofbauer was a speaker at the Second Autumn Course in Mathematical Ecology held in Trieste, Italy, he answered a knock on his hotel room door at midnight to face three Policia armed with machine guns. At the time Dr. Hofbauer spoke only a little Italian and the Policia spoke only Italian. These facts were inconsequential, as Dr. Hofbauer was forcibly escorted to the local jail. As a director of the course, I was awakened from a deep sleep and told of the situation. At 2:30 a.m. I was at the jail trying to convince the local authorities that this guy was really a mathematician and not the crook who had stolen Hofbauer's passport two years previously (and who was now resting comfortably in jail in Austria). While I still hold the Italian police responsible for a stupid act and for a sleepless night, I feel that Josef had nothing to do with the situation, so I will try to be as objective in the review as my academic prejudices permit.

Hofbauer and Sigmund indicate in the Preface that "... crucial aspects of theoretical biology can only be captured by mathematical modelling; and just as important as the mathematical applications in biology are the biological motivations to mathematics." The maturity of the field of mathematical biology does indeed rest on the interplay between the mathematics and the biology. Any attempt to do justice to both areas requires sincere efforts; it is clear that the authors have invested much effort in this work. It is also evident that this book is written for mathematicians. Even the biologically oriented sections often include models and mathematics that many biologists would find challenging.

The book addresses a spectrum of topics ranging from the prebiotic evolution of macromolecules to population genetics, dynamic population, and community ecology, and to game-theoretic modelling of animal behavior. It consists of seven parts. Parts II and V are concerned with models in population and community ecology and concentrate on the dynamics of the classical community models of Lotka–Volterra type. The presentation is a good survey of the Lotka–Volterra literature and is strongly influenced by the authors' interest in qualitative theory and their work on permanence and persistence. The remainder of the book treats aspects of evolutionary ecology. Unfortunately for those interested in ecology, there is little indication of the applicability (or lack of applicability) of these community models to natural systems.

The sections on evolutionary biology begin with the Hardy–Weinberg law and range to consideration of evolutionary game theory. The techniques are primarily deterministic, although a few stochastic approaches are indicated. Again, many of the models studied here are of Lotka–Volterra type. In the Afterword, some limitations of the evolutionary approaches are recognized.

The semester before I received the request to review this book, our mathematical ecology seminar group used it as our seminar study book. Students (with varied backgrounds but mostly from the Mathematics Department or the Ecology Program) and faculty presented and discussed the material. Most of our math graduate students had just completed the first semester of a mathematical ecology course. Our less mathematically mature students had considerable trouble with the intensity of the mathematics. Our students also found the biological presentations interesting at times. In our opinion, the audience for this book should be mathematicians with a decent background in analysis and differential equations and a desire to learn more about dynamical systems and applications of mathematics to biology. It served our seminar study needs well because the survey of some fields of research was useful and the presentation provoked many discussions on the relevance of mathematics to biology.

The authors indicate the hope that this book is (i) an introduction to the theory of dynamical systems based entirely on examples from biology, and (ii) a survey of some recent developments in evolution. They also "hope to point out a few interesting sights along the way." They have accomplished their limited objectives well. The book belongs to a student textbook series of a mathematical society. In my opinion, the uses of the book as a classroom text are rather limited; indeed, as the authors caution, this specialized book is not intended to serve as a text in differential equations. However, the book is well written; it does present a good survey of qualitative behavior of generalized Lotka–Volterra systems; and it deserves to be in the library of mathematicians who enjoy clever applications of mathematics in biological settings.

THOMAS G. HALLAM
University of Tennessee, Knoxville

Natural Resource Economics: Notes and Problems. *By Jon M. Conrad and Colin W. Clark.* Cambridge University Press, Cambridge, UK, 1987. x + 231 pp. $39.50, cloth, ISBN 0-521-53188-9; $14.95, paper, ISBN 0-521-33769-0.

The late Elliott Montroll once applied the theory of natural selection to items offered for sale in the Sears Catalogue, and the result was a delectable morsel. Advertisements grew as items flourished and waned as sales declined. There was even extinction when an issue finally appeared with a particular article no longer offered for sale. The study was no doubt intended primarily as entertainment; nevertheless, it stimulates reflection on a number of other human enterprises as well. It is interesting to view the intellectual endeavor of a scholarly community in this way as individuals seek to find the niches where they and their disciples can flourish.

And the authors of this book have found a niche. It is not so much the specific content of the book that gives it survival value (although that surely contributes) as its filling a need in the literature for more books giving students practical applications. Many advanced textbooks, even in areas of applied mathematics, give the student little insight into the difficulties of computing solutions of even the most rudimentary problems.

It will help those who contemplate the use of this book to see precisely where it fits in the scheme of training the practitioners of mathematics. The problem of applying mathematical theory to the real world in any fashion is threefold. The first aspect is conceptual. One must learn the art of creating a mathematical grid through which to view some part of the real world. To some this part of the process is natural and subconscious just as the wearing of glasses becomes with prolonged use. The model becomes reality itself. One sees an anamorphic view of the world as though it were undistorted. However, in our ideal the applied mathematician retains a clear distinction between model and reality.

The second aspect is one of alignment. Parameters must be adjusted, and certain fiduciary marks must match the measurements of the real world, so that the quantitative aspects of the model are normalized. Parameter estimation and model verification usually use statistical tools. This aspect of applied mathematics may require collaboration with one who is expert in the experimental techniques in the area of application.

The third aspect of applying mathematical theory is that of determining the features of the model itself. In an earlier era, this meant the application of analytical techniques to compute and/or estimate the behavior of the model. In the age of computers we have a completely new paradigm. One must have a handy toolbox of computer techniques (and, of course, a computer), a ready capability to estimate the errors of various calculations, and the ability to put the results into easily assimilable graphical