

Preface

Population dynamics is the area of science which tries to explain in a simple mechanistic way the time variations of the size and composition of biological populations, such as those of humans, animals, plants or microorganisms. It is related to, but still quite distinct from, the more descriptive area of population statistics. One common point is that they make extensive use of mathematical language.

Population dynamics is at the intersection of various fields: mathematics, social sciences (demography), biology (population genetics and ecology) and medicine (epidemiology). As a result it is not often presented as a whole, despite the similarities between the problems met in various applications. A notable exception in French is the book *Mathematical Population Theories*¹ by Alain Hillion. But it presents the subject from the point of view of the mathematician, distinguishing various types of model: discrete-time models ($t = 0, 1, 2, \dots$) and continuous-time models (t is a real number), deterministic models (future states are known exactly if the present state is known exactly) and stochastic models (where probabilities play a role). The book then considers logically discrete deterministic models, continuous deterministic models, discrete stochastic models and continuous stochastic models.

In the present book I have tried to discuss the same subject but from a historical point of view. Research is explained in its context. Short biographies of scientists are included. This should make the book easier to read for those less familiar with mathematics and can usually help in understanding the origin of the problems under study. But this book is not just about history. It can also serve as an introduction to mathematical modelling. It seemed important to include the details of most computations so that the reader can really see the limitations of the models. Technical parts are emphasized in grey boxes and can be skipped at first reading. The last chapter focuses on the numerous contemporary problems in population dynamics that one can try to analyze from a mathematical point of view. For those who would like to know more, the lists of references at the end of each chapter also include web sites from which original articles may be downloaded.

¹ Presses Universitaires de France, Paris, 1986. For English readers, *Quantitative Methods in Biological and Medical Sciences* by H.O. Lancaster (Springer-Verlag, 1994) gives a good historical overview without the mathematical details.

It was not possible in a book of this length to give a complete picture of all the work developed until now or to talk about all the scientists who have contributed to the subject. The choice made necessarily contains an arbitrary component, particularly for the most recent decades. I hope nevertheless that the sample chosen is representative enough, and that people active in the field whose work is not mentioned will not be upset.

The ideal audience for this book would include:

- High school and university students wondering what links may exist between the mathematics courses they have to attend and the world around them, or students preparing personal work on a theme related to population dynamics.
- Mathematics teachers trying to make their course more attractive. The knowledge of the four elementary operations is enough to understand most of Chapters 1, 2 and 5. Chapter 3 can serve as an introduction to the applications of logarithms. This book also covers: recurrence equations in Chapters 1, 3, 8, 11, 14, 21, 23, 24; differential equations in Chapters 4, 6, 12, 13, 16; partial differential equations in Chapters 20, 25; an integral equation in Chapter 10; and applications of probability theory in Chapters 2, 7, 8, 9, 15, 16, 17, 18, 19, 22.
- People already familiar with demography, epidemiology, genetics or ecology and willing to compare their favourite area with others which may involve similar mathematical models.
- Readers interested in the history of science.

This book is essentially a translation of the French edition published by Cassini Éditeurs (Paris) in 2008 under the title *Histoires de Mathématiques et de Populations*. Some chapters have been reorganized or rewritten. Four figures have been added. A few misprints have been corrected. The lists of references at the end of each chapter have been extended and updated. These lists include web sites showing the original works.

A reference followed by a URL means that it can be easily found – at least in part – by searching on the World Wide Web (e.g. through Google Books).

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Nicolas Bacaër

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Bacaër, N.

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