



John M. Fryxell, Anthony R. E. Sinclair and Graeme Caughley

# Wildlife Ecology, Conservation, and Management

**THIRD EDITION**

Companion Website



WILEY Blackwell

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**Third Edition**

**John M. Fryxell PhD**

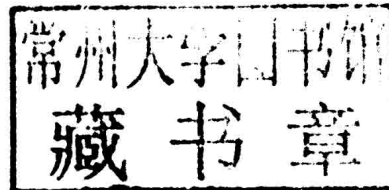
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# Wildlife Ecology, Conservation, and Management

To our colleagues Graeme Caughley, Jamie Smith, and Peter Yodzis,  
who have influenced both our approach to wildlife biology and the  
writing of this book.

# Preface

Modern principles of sustainable management and conservation of wildlife species require a clear understanding of demography, animal behavior, and ecosystem dynamics. Our book weaves together these disparate elements in a single coherent text intended for senior undergraduate and graduate students. The first half provides a solid background in key ecological concepts such as demography, population growth and regulation, competition within and among species, and predator–prey interactions. The second half uses these key ecological concepts to develop a deeper understanding of the principles underlying wildlife management and conservation, including population viability assessment, sustainable harvesting, landscape planning, and ecosystem management.

New quantitative methods, developed over the last 10 years, are now so fundamental to management that we have included them at the most basic levels. Several chapters of the book will be useful to practicing wildlife managers. For example, we have included modern approaches to estimating animal abundance and habitat selectivity, the use of age- and stage-structured data in demography studies, and the use of models as efficient methods for making conservation and management decisions. As a study aid, we have included a wide variety of downloadable computer programs in R and Mathcad on an accompanying website. These are intended to help readers develop a solid understanding of key statistical procedures and population models commonly used in wildlife ecology and management.

In this edition we have arranged the sequence of chapters to reflect the progression from individuals to populations, communities, and ecosystems. Four new chapters have been added to cover rapidly developing topics: effects of climate change on wildlife, the evolutionary response by wildlife populations to rapidly changing conditions, home range use and habitat selection as a consequence of patterns of individual movement, and the importance of corridor use and metapopulation dynamics for wildlife populations living in the highly fragmented landscapes that increasingly characterize the modern world.

Anne Gunn and David Grice were invaluable in bringing together the first edition of this book after Graeme Caughley fell ill. Fleur Sheard prepared the line drawings for that edition. Since then we have continued to benefit from the helpful contributions of a number of people, including Tal Avgar, Andrew McAdam, Cort Griswold, David Grice, Sue Briggs, Andrea Byrom, Steve Cork, Charles Krebs, Graham Nugent, John Parkes, Roger Pech, Laura Prugh, Wendy Ruscoe, Dolph Schluter, Julian Seddon, Grant Singleton, David Spratt, Eric Spurr, Vernon Thomas, and Bruce Warburton. We also thank the Natural Sciences and Engineering Research Council of Canada for continuing support over the years.

Our close friend and colleague, Graeme Caughley, died in 1994. We have retained the substance and spirit of his scholarship, expanding the fields where advances have occurred since the first edition. For this new edition we are indebted to Sue Pennant and Anne Sinclair, who are always willing (if not necessarily eager) to provide a fresh set of eyes for proofreading of the new material.

# About the companion website

This book is accompanied by a companion website:

[www.wiley.com/go/Fryxell/Wildlife](http://www.wiley.com/go/Fryxell/Wildlife)

The website includes:

- Additional resources
- Powerpoints of all figures from the book for downloading
- PDFs of all tables from the book for downloading





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# 1 Introduction: goals and decisions

## 1.1 How to use this book

This book is structured as two interlocking parts. The first provides an overview of wildlife ecology, as distinct from that portion of applied ecology that is called wildlife management and conservation. The chapters on wildlife ecology (Chapters 2–11) cover such topics as growth and regulation of wildlife populations, spatial patterns of population distribution, and interactions among plants, herbivores, carnivores, and disease pathogens. While these topics are often covered in introductory biology or ecology courses, they rarely focus on the issues of most concern to a wildlife specialist. A solid understanding of ecological concepts is vital in formulating successful wildlife conservation and management policy. In particular, you will need an understanding of the theory of population dynamics and of the relationship between populations, their predators, and their resources if you are to make sensible judgments on the likely consequences of one management action versus another.

The second section deals with wildlife conservation and management (Chapters 12–22). These chapters cover census techniques, how to test hypotheses experimentally, how to evaluate alternative models as tools for conservation and management, and the three major aspects of wildlife management: conservation, sustained yield, and control. In closing, Chapter 22 places the problems of wildlife management into the context of the ecosystem. Species populations cannot be managed in isolation because they are influenced by, and they themselves influence, many other components of the ecosystem. In the long run, wildlife management becomes ecosystem management.

Many of the key issues in wildlife ecology are of a quantitative nature: processes of population growth, spatial distribution, or interactions with the physical environment or other organisms. Coping with these topics demands conceptual understanding of quantitative ecology. Mathematical models are also an essential component of decision-making in both wildlife conservation and management, for the simple reason that we can rarely rely on previous experience to identify the most appropriate choices. Every problem is unique: new species, new sets of challenges and constraints, all taking place in a continually changing physical environment. Mathematical models provide a useful tool for dealing appropriately with these uncertainties. Moreover, mathematical models help to clarify the logic that guides our thinking.

To assist in developing the requisite skills, many of the models and statistical analyses covered in the book can be obtained via a link at Fryxell's departmental Web page (<http://www.uoguelph.ca/ib/people/faculty/fryxell.shtml>). This provides a set of text files suitable for application using "R," a nonproprietary (i.e. free) software package that has been developed by a hard-working and highly committed group



of professional scientists and statisticians from all around the world. By learning to perform the examples used to illustrate this book, you will both expand your familiarity with useful mathematical principles and hone the problem-solving skills involved in modern wildlife ecology, conservation, and management. This can prove invaluable in future professional endeavors.

The R package provides a powerful set of integrated tools for numerical computation, statistical analysis, and graphical depiction of data and results. More information about R can be found at the R project homepage, [www.r-project.org](http://www.r-project.org), while instructions on how to download R can be found at the CRAN repository for R materials, <http://cran.r-project.org>.

## 1.2 What is wildlife conservation and management?

The remainder of this chapter explains what wildlife management is, how it relates to conservation, and how it should operate. We discuss the difference between value judgments and technical judgments and how these relate to goals and policies compared to options and actions; we enumerate the various steps involved in deciding what to do and how to do it; and we describe decision analyses and matrices and how they help in evaluating feasible management options.

*Wildlife* is a word whose meaning expands and contracts according to the viewpoint of the user. Sometimes it is used to include all wild animals and plants. More often it is restricted to terrestrial vertebrates. In the discipline of wildlife management it designates free-ranging birds and mammals, and that is the way it is used here. Until about 25 years ago, “wildlife” was synonymous with *game*: those birds and mammals that were hunted for sport. The management of such species is still an integral part of wildlife management, but increasingly it embraces other aspects too, such as conservation of endangered species.

*Wildlife management* may be defined for present purposes as the *management of wildlife populations in the context of the ecosystem*. That may be too restrictive for some, who would argue that many of the problems of management deal with people and, therefore, that education, extension, park management, law enforcement, economics, and land evaluation are legitimate aspects of wildlife management and ought to be included within its definition. They have a point, but the expansion of the definition to take in all these aspects diverts attention from the core around which management activities are organized: the manipulation or protection of a population to achieve a goal. Obviously, people must be informed as to what is being done; they must be given an understanding of why it is necessary, their opinions must be canvassed, and their behavior may have to be regulated with respect to that goal. However, the most important task is to choose the right goal and to know enough about the animals and their habitat to ensure its attainment. Hence, wildlife management is restricted here to its literal meaning, thereby emphasizing the core at the expense of the periphery of the field. The broader extension and outreach aspects of wildlife management are dealt with thoroughly in other texts devoted to those subjects (Lyster 1985; Geist and McTaggart-Cowan 1995; Moulton and Sanderson 1999; Vásárhelyi and Thomas 2003).

### 1.2.1 *Kinds of management*

Wildlife management implies stewardship; that is, the looking after of a population. A population is a group of coexisting individuals of the same species. When stewardship fails, conservation becomes imperative. Under these circumstances, wildlife management shifts to remedial or restoration activities.