# Adaptation, Diversity, and Ecology Company of the Cology FELDHAMER DRICKAMER VESSEY MERRITT



## Adaptation, Diversity, and Ecology Output Diversity, and Ecology Output Diversity, and Ecology

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### MAMMALOGY: ADAPTATION, DIVERSITY, AND ECOLOGY

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This book is printed on recycled, acid-free paper containing 10% postconsumer waste.

456789 KGPKGP 065432

ISBN 0-697-16733-X

Vice president and editorial director: Kevin T. Kane

Publisher: Michael D. Lange

Sponsoring editor: Margaret J. Kemp

Senior developmental editor: Kathleen R. Loewenberg

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Designer: K. Wayne Harms

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Art editor: Jodi K. Banowetz Compositor: Precision Graphics Typeface: 10/12 ACaslon Regular

Printer: Quebecor Printing Book Group/Kingsport

Cover/interior design: Kristyn Kalnes

Cover image: Kathy Bushue/Tony Stone Images

Illustrator: ISIS/Sandra R. Sevigny

The credits section for this book begins on page 544 and is considered an extension of the copyright page.

### Library of Congress Cataloging-in-Publication Data

Mammalogy: adaptation, diversity, and ecology / George A. Feldhamer . . . [et al.].

p. cm.

Includes bibliographical references and index.

ISBN 0-697-16733-X

1. Mammalogy. I. Feldhamer, George A.

QL703.M36 1999

599-dc21

98-12994

CIP

# PREFACE

The amount of information available on mammals has increased dramatically in the last 25 years. In Mammalogy: Adaptation, Diversity, and Ecology, we have attempted to "make sense" of this information explosion. Any such attempt is a balancing act between breadth and depthenough breadth to include numerous subject areas within mammalogy and sufficient depth to avoid superficiality. In terms of form and function, the approximately 4600 species of mammals represent the most diverse class of vertebrates. Mammals are terrestrial, arboreal, or marine; they burrow, run, or fly; and they feed on meat, nectar, blood, pollen, leaves, or a variety of other things. They range in size from 3-gram pygmy shrews and hog-nosed bats to 160-milliongram blue whales. Mammalogy can be approached from a variety of directions and subdisciplines—anatomy and physiology, behavioral ecology, molecular genetics, systematics, conservation, zoogeography, and paleontology, to list a few—all of which ultimately are complementary and interrelated. We explore the diversity and complexity of mammalian form and function in this textbook, as well as phylogenetic and ecological relationships.

Mammalogy: Adaptation, Diversity, and Ecology is intended for use in upper-division undergraduate and graduate courses with students who have a basic background in vertebrate biology. The book's length is tailored to a one-semester mammalogy course.

The text consists of 29 chapters arranged in 5 parts. In part I (chapters 1 through 4), we introduce the subject of mammalogy, the history of the discipline, methods (including current molecular techniques important in systematics and population analyses), and the evolution of mammals. In part II (chapters 5 through 9), we discuss biological functions and physical structure of mammals. Adaptive radiation in form and structure among the currently recognized orders is covered in part III (chapters 10 through 19). Morphology, fossil history, conservation and economics, and a brief synopsis of all extant families are covered for each order. Behavioral, ecological, and zoogeographical considerations are the focus of part IV (chapters 20 through 26). Finally, in part V (chapters 27

through 29), we explore mammalian parasites and diseases, including zoonoses, domestication of mammals, and conservation issues. Suggested readings and questions designed to help generate critical thinking and discussion are found at the conclusion of each chapter. Literature cited within a chapter is collected at the end of the text to avoid redundancy. Technical terms are in boldfaced type the first time they appear and are defined in both the text and the glossary. Although there is continuity between the part divisions and chapters of the text, instructors can select certain chapters based on individual interest, emphasis, or time constraints without sacrificing clarity and understanding.

All four of us bring several years of field and laboratory experience with mammals in a variety of settings—as well as our individual specializations, viewpoints, and biases—to the endeavor of writing this book. We have benefited from this collaboration and hope it is reflected in the text. More important, we have profited through the years from the suggestions, ideas, and constructive criticism of many teachers, colleagues, students, and friends.

We want to express our appreciation to the many reviewers who read drafts of this text in part or in whole.

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Many other persons helped significantly in the preparation of the text, including Marge Kemp, Kathy Loewenberg, Gloria Schiesl, Mary Reeg, Jodi Banowetz, Sandra Sevigny, LouAnn Wilson, and Linda Davoli. We also thank science librarian Kathy Fahey and her staff at Southern Illinois University at Carbondale for their assistance throughout this project. Thanks also to Marjorie K. Laughrey, Colleen Hannaken, and Kristin Vessey for their editorial assistance.

We hope this book does justice to past and present mammalogists upon whose research and teaching efforts it is largely based. Just as important, we hope that it will prove useful to students who will be the mammalogists of the future and that through it, students will better appreciate and explore the mysteries of mammals—those "fabulous furballs."

### About the Authors

George A. Feldhamer is a associate professor of zoology, and coordinator of the Environmental Studies Program, at Southern Illinois University at Carbondale. His research has focused exclusively on mammalian populations, ecology, and management; introduced cervid biology; and threatened and endangered species. He is a former associate editor of the Wildlife Society Bulletin, and coeditor of Wild Mammals of North America: Biology, Management, and Economics. He is curator of the mammal collection at SIUC and has 20 years of experience teaching an upper division mammalogy course.

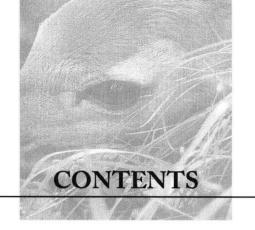
Lee C. Drickamer is a professor of zoology at Northern Arizona University. Prior to this he, had been a professor of zoology at Southern Illinois University at Carbondale for 11 years. He is a past-president of the Animal Behaviour Society, past-secretary-general of the International Council of Ethnologists, past chair of the Division of Animal Behavior of what is now the Society for Integrative and Comparative Biology, and former editor of Animal Behaviour. His research emphases have included social factors affecting development and reproduction in house mice and swine, behavioral ecology of house mice and deer mice, social biology of primates, intrauterine position effects on behavior and reproduction of mice and swine, and the consequences of mate selection for offspring viability in house mice.

Stephen H. Vessey is professor emeritus of biological sciences at Bowling Green State University. His research interests include the behavioral ecology of mammals, especially primates and rodents. He has been studying a population of white-footed mice in northwestern Ohio for more than 25 years. He is a former associate editor of the *Journal of Mammalogy* and is a Fellow of the Animal Behavior Society. He has taught mammalogy and animal behavior at Bowling Green for 28 years, coauthoring a textbook in animal behavior with Lee Drickamer.

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## Adaptation, Diversity, and Ecology Output Description Adaptation of the property of the pro

### PART ONE

### Introduction



Although widely distributed throughout much of North America, bobcats (Lynx [Felis] rufus) are rarely seen.



### THE STUDY OF MAMMALOGY

WHAT IS MAMMALOGY?
WHY STUDY MAMMALS?
RESOURCES FOR MAMMALOGISTS
ORGANIZATION OF THE BOOK

### WHAT IS MAMMALOGY?

ammalogy is the study of the animals that constitute the Class Mammalia, a taxonomic group of vertebrates (Phylum Chordata, Subphylum Vertebrata) within the Kingdom Animalia. Humans (*Homo sapiens*) are mammals, as are many domesticated species of pets and livestock, as well as wildlife, such as deer and squirrels, with whom we share our natural surroundings (figure 1.1). Many of the species of animals, such as elephants, whales, large cats, and the giant panda, that have aroused public concern for their survival are mammals.

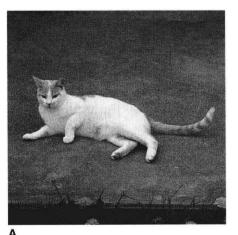
Mammals share a number of common features, including (1) the capacity for internal temperature control, often aided by a coat of fur; (2) the possession of mammary glands, which, in females, provide nourishment for the young during early development; and (3) with a few exceptions, the ability to give birth to live young. These and many other features of mammals are discussed in detail in chapter 4 and in parts II and III.

Animal biology can be studied from a taxonomic perspective, that is, by concentrating on groups of organisms, such as mammals (mammalogy) or birds (ornithology). Or, the functional perspective can be used, concentrating on processes, as in physiology and ecology. In this book, we combine both approaches. The disciplines of biochemistry, physiology, animal behavior, and ecology, among many others, all contribute to mammalogy. Our goal is to explore and integrate discoveries from all these disciplines to provide the most enlightening and productive approach to the study of mammals.

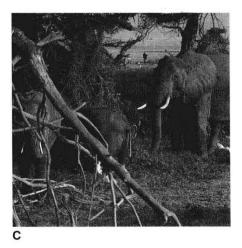
Throughout the book, we weave together at least four major themes: evolution, methods for investigating mammals, diversity, and the interrelationships of form and function. A basic underlying theme for all of biology is evolution by natural selection. Beginning with chapter 4, we take up the thread of evolutionary thought, giving particular emphasis to both speciation and adaptations of mammals. Chapter 3 begins the second thread, scientific methods, which deals with how mammalogists formulate questions (hypotheses) for investigation and what methods they use to answer these questions. The third thread, which is covered in parts II and IV, involves how form, function, and behavior are tightly interwoven and shaped by natural selection to provide solutions to the key problems of survival and reproduction in mammals. Our fourth thread, mammalian diversity, is emphasized in part III, but examples offered throughout the text further underscore this theme.

### WHY STUDY MAMMALS?

Most of us have at least a passing interest in mammals, but we seldom stop to think why the formal study of mammalogy is important. Mammalogy can be approached from a variety of directions and for diverse reasons (Wilson and Eisenberg 1990). Mammals were a resource for early humans. Knowledge about them was important if humans were to successfully hunt or trap them. Some mammals, such as the sabre-toothed cats that coexisted with early humans, were potential predators on humans. Knowledge of their habits was important for survival. Indeed, there are still locations throughout the world where wild animals, including grizzly bears (Ursus arctos) in western North America, may attack and kill humans. Mammals continue to be important to humans as food. People with a subsistence way of life may depend on capturing or killing free-ranging mammals. More industrialized cultures depend on domesticated livestock for food. In addition, humans have a long tradition of using in







**Figure 1.1** Mammals with whom we share the world. In addition to our own species, mammals with whom we share our world can be grouped roughly into (A) domestic pets and livestock, such as a house cat (*Felis silvestris*), (B) wildlife in our familiar environment, which we may see often or in other cases rarely, such as a fox squirrel (*Sciurus niger*), and (C) wildlife from other lands, particularly endangered or threatened species, such as an African elephant (*Loxodonta africana*).