

HANDBOOK
of
CENSUS METHODS
for
TERRESTRIAL
VERTEBRATES

David E. Davis

CRC Handbook of Census Methods for Terrestrial Vertebrates

Editor

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PREFACE

This handbook is the first attempt to record various procedures for determining the number of vertebrates in an area. It properly belongs in the CRC Series of Handbooks because it aspires to reach the level of proficiency of methods for older areas of biology, such as microbiology. Being a first attempt it lacks the polish and consistency of older disciplines. The handbook can be supplemented by some statistical and ecological handbooks that discuss more general topics. The user, however, should be able to start a census program from the information in this book.

The authors of the articles on various species made this book possible. Without their generous and enthusiastic cooperation these methods would not be presented. The ecological community owes them a debt of gratitude. In addition, I recognize the merit of the members of the Advisory Board who discussed and improved the concept of a handbook, who read the articles, and who reviewed the Introductory chapter and the chapter entitled "Calculations Used in Census Methods". Their help gives me confidence that the handbook fulfills a need.

David E. Davis
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FOREWORD

Henry Mosby

Any method, technique, or procedure which provides an acceptable estimation of abundance of a population of free-living animals would be a boon to the wildlife manager, investigator, or administrator. Estimating the number and structure of a given wildlife population has commanded the attention of biologists from time immemorial. Unfortunately, no single or best technique is yet developed that is suitable for all populations under every circumstance; it seems unlikely that such a panacea will be discovered because of the large number of variables encountered in the plethora of wild species of interest to humans. This publication seeks to summarize under one cover the most satisfactory procedures developed by knowledgeable wildlifers working with a large variety of vertebrates. The judicious application of the information here assembled should aid materially in the wise use of our vertebrate wildlife resources.

It is needless to emphasize that wild animal population numbers are subject to continuous change, both annually and periodically. Thus, "census" techniques of any type (direct, sample, or indexes counts) obviously must not require excessive periods of time for their successful application. The acceptable period of time for a meaningful estimate probably varies inversely with the average annual mortality rate of the species, e.g., a short period for the cottontail rabbit and a longer period for the black bear. Likewise, as emphasized by Davis in the chapter entitled "Calculations Used in Census Methods", the management importance of the estimate should govern the cost (time and accuracy) of the technique employed. Obviously, a long-time and high-cost population estimate may be illogical unless the importance of the decisions based on this estimate justified the efforts expended. Frequently, many of us employ an inventory technique with which we are most familiar or which we consider "best" with little or no consideration of the cost-benefit aspects of our efforts.

Lord Kelvin is reputed to have said: "If you haven't measured it, you don't know what you are talking about." Thus, some *measure* of abundance is necessary before any population biologist can hope to draw meaningful conclusions about the status of a species-population. Any measurement, however crude, is superior to no measurement, provided the limitations (precision) of the measurement are clearly stated. Most measurements are mathematically expressed, of course, and mathematically speaking a finite figure permits no interpretation; 10 is 10, no more and no less. Thus, the wildlife biologist who seeks to enumerate any given population is duty-bound to state clearly the reservations with which his mathematically expressed "census" must be accepted or used. The discussion of these limitations in the articles of this publication demand the attention of any individual who seeks to estimate the abundance of populations of wild vertebrates.

The ultraconcise treatment of "census" methods employed with the 130-odd species contained in this publication is dictated by space limitations. These summaries have been prepared by individuals who have personal, hands-on experience in attempting to assess the abundance of the given species. The summary-statement presentations should not be construed to infer that the techniques found best for a given species in a stated area or habitat may be applied everywhere in a "cookbook" manner. No methodology, however sophisticated, relieves the wild population researcher or manager from exercising sound biological and mathematical judgments in both preparing and acting on the results of his effort to estimate animal numbers. In short, biologists who know intimately the ecology of the species he is "censusing", greatly increases

his probability of deriving a meaningful estimate. Those individuals who prepared and presented the species treatments in this handbook have such knowledge.

Leopold pointed out some half-century ago that continuous censusing is the basis of sound wild-species management. This publication should contribute materially to our efforts to deal intelligently with our wild vertebrate populations. Present day and future conditions as they can now be seen all suggest urgently that we must apply all the intelligence possible to wild populations unless we are willing to accept drastic losses of and from various wild species. There are many persons who do not and will not willingly accept such losses. The application of the basic tool of "censusing" wild populations as outlined in this book, is a noteworthy effort to meet this challenge.

THE EDITOR

Dr. David E. Davis has studied animal numbers for many years. He graduated from Swarthmore (1935) and obtained a Ph.D. at Harvard (1939). He conducted research in Cuba (1937—1938), Argentina (1940), and Brazil (1941—1943). He then worked on typhus fever for the Public Health Service in Texas (1943—1945). His first academic position was at the Johns Hopkins School of Hygiene and Public Health where he developed census methods for reservoirs of diseases. He then moved to Pennsylvania State University (1959—1967) and continued teaching and research on populations. He was head of the Department of Zoology (1967—1975) at North Carolina State University. Currently he is a Research Associate at the Santa Barbara Museum of Natural History and also at the University of California at Santa Barbara.

He has published about 250 papers on populations, behavior, physiology, and ecology as well as 3 books. He has edited two journals.

Dr. Davis is active in several organizations. He was president of the Wildlife Disease Association, the American Institute of Biological Sciences, and the Biological Sciences Information Service (*Biological Abstracts*). He currently is a member of the board for *Zoological Record* and of the Science Advisory Panel for Pesticides of the Environmental Protection Agency.

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