

Monitoring vertebrate populations using observational data

Wesley M. Hochachka, Kathy Martin, Frank Doyle, and Charles J. Krebs

Abstract: Methods for monitoring temporal changes in population size vary from intensive and potentially expensive to less intensive and more easily implemented techniques. In this paper we evaluate the utility of a monitoring technique that can be used to follow many vertebrate species simultaneously at low cost and requires little training of personnel. Observers record the number of individuals seen per hour in the field and these rates of encounter are used as an index of population size. We examine whether encounter rates reflect population size by comparing them with independent censuses of three species over a 7-year period in the boreal forest near Klusane Lake in the southern Yukon Territory. Encounter rates were generally an accurate reflection of variation in population size. In our study system, inter-observer variability did not influence our ability to detect fluctuations in population size; the underlying fluctuations were detected whether data from all or only a group of "high-quality" observers were used. In our study, the benefit of using all available data outweighed the cost of variation among observers because sample sizes were large (averaging over 1200 data points from 33 observers per year). Variation in the length of observation periods did not affect the chance of detecting animals in our study. Encounter rates provide a reasonable index of variation in population size, although caution should be used with species that are uncommon or difficult to detect.

Résumé : Les méthodes d'estimation des changements temporels de taille des populations vont des méthodes intensives, potentiellement onéreuses, aux méthodes moins intensives souvent plus faciles à utiliser. Nous évaluons ici une méthode d'estimation adaptée à suivre plusieurs espèces de vertébrés simultanément, méthode qui ne coûte pas cher et qui requiert peu d'entraînement de personnel. Les observateurs notent le nombre d'animaux aperçus en 1 h sur le terrain et ce nombre sert d'indice de la taille de la population. Nous examinons si la fréquence de ces rencontres reflète la taille des différentes populations en comparant les chiffres obtenus avec les résultats de recensements de trois espèces effectués indépendamment pendant une période de 7 ans dans la forêt boréale de la région du lac Klusane, dans le sud du Yukon. La fréquence des rencontres est généralement un indice assez exact de la taille des populations. Dans notre système, la variabilité inter-observateurs n'influence pas la capacité de détecter les fluctuations dans l'effectif des populations : les fluctuations de la taille de la population ont été détectées dans les cas où les données de tous les observateurs de « haute qualité » ont été utilisées aussi bien que dans les cas où seulement celles d'un groupe d'entre eux ont été utilisées. Dans cette étude, les avantages à utiliser toutes les données disponibles excèdent les coûts reliés à la variation entre les observateurs, à cause de l'importance des échantillons (en moyenne, plus de 1200 données enregistrées par 33 observateurs par année). La variation dans la durée des périodes d'observation n'affecte pas la probabilité de détecter la présence d'un animal. La fréquence des rencontres donne des indices réalistes de la variation de la taille des populations, mais il faut user de prudence dans le cas d'espèces peu communes ou difficiles à repérer.

[Traduit par la Rédaction]

Introduction

Numerous techniques have been developed for estimating abundance in animal populations, and they vary in the amount of effort required to conduct the work. Direct census (e.g., Falls 1981) and mark-recapture (e.g., White et al. 1982; Pollock et al. 1990; Krebs 1999) provide data on actual numbers of animals but require intensive effort to obtain information on one or a few species. Other highly standard-

ized monitoring methods such as the North American Breeding Bird Survey (e.g., Robbins et al. 1986) and constant-effort mist-netting (e.g., Ralph et al. 1993) provide indices of abundance for several species simultaneously, but still require a considerable amount of effort directed specifically towards the census work. However, there are circumstances in which information on relative population size is required but it is logistically impossible to expend the time and effort solely on intensive censusing. One type of census

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W.M. Hochachka,¹ Cornell Laboratory of Ornithology, Ithaca, NY 14850, U.S.A.

K. Martin, Centre for Applied Conservation Biology, Faculty of Forestry, The University of British Columbia, 2357 Main Mall, Vancouver, BC V6T 1Z4, Canada.

F. Doyle and C.J. Krebs, Department of Zoology, The University of British Columbia, 6270 University Boulevard, Vancouver, BC V6T 1Z4, Canada.

¹Author to whom all correspondence should be sent at the following address: Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, NY 14850, U.S.A. (e-mail: wrmh6@cornell.edu).

Monitoring Vertebrate Populations

Gordon H. Rodda



Monitoring Vertebrate Populations:

Monitoring Vertebrate Populations William L. Thompson, Gary C. White, Charles Gowan, 1998-08-17 This book is written to serve as a general reference for biologists and resource managers with relatively little statistical training. It focuses on both basic concepts and practical applications to provide professionals with the tools needed to assess monitoring methods that can detect trends in populations. It combines classical finite population sampling designs with population enumeration procedures in a unified approach for obtaining abundance estimates for species of interest. The statistical information is presented in practical, easy-to-understand terminology. Presented in practical, easy-to-understand terminology. Serves as a general reference for biologists and resource managers. Provides the tools needed to detect trends in populations. Introduces a unified approach for obtaining abundance estimates.

Monitoring Plant and Animal Populations Caryl L. Elzinga, Daniel W. Salzer, John W. Willoughby, James P. Gibbs, 2009-05-11 Monitoring Plant and Animal Populations offers an overview of population monitoring issues that is accessible to the typical field biologist and land managers with a modest statistical background. The text includes concrete guidelines for ecologists to follow to design a statistically defensible monitoring program. User-friendly practical guide written in a highly readable format. The authors provide an interdisciplinary scope to address the current widespread interest in monitoring in many environmental fields including pure and applied ecology, conservation biology, and wildlife management. Emphasizes the role of monitoring in adaptive management. Defines important terminology and contrasts monitoring with other data collection activities. Covers the applicable principles of sampling and shows how to design a monitoring project. Provides a step-by-step overview of the monitoring process illustrated by flow charts and references. The authors also offer guidelines for analyzing and interpreting monitoring data. Illustrates the foundation of management objectives and describes their components, types, and development. Describes common field techniques for measuring important attributes of animal and plant populations. Reviews different methods for recording monitoring data in the field, managing the data, and communicating data to policymakers.

Monitoring Animal Populations and Their Habitats Brenda C. McComb, Benjamin Zuckerberg, David G. Vesely, Christopher A. Jordan, 2020 We designed this book to offer a comprehensive overview of the monitoring process from start to finish. Although there are books that deal with sampling design and the quantitative analysis of population data, there are few that provide practical advice covering the entire evolution of a monitoring plan from incorporating stakeholder input to data collection to data management and analysis to reporting. This book strives to present an overview of this process. We also acknowledge that any such effort tends to reflect the interests and expertise of the authors, and as such, there is a distinct emphasis on monitoring vertebrate populations and upland habitats. Although many of our examples tend to focus on bird populations and forested habitats, we have made an attempt to cover other taxa and habitat types as well, and many of the recommendations and suggestions that we present are applicable to a diversity of monitoring programs. This book was written to fill a practical

need and also to embrace a set of values that we hold dear We wanted a book that could be used in a classroom because we feel that students in natural resources programs need to know how to design a monitoring program when they enter the workforce We also realize that many former students now in the workforce did not have that training and may find this book of value to them

Proceedings RMRS. ,1998 *Wildlife Study Design* Michael L. Morrison,William M. Block,M. Dale Strickland,Bret A. Collier,Markus J. Peterson,2008-03-21 We developed the first edition of this book because we perceived a need for a compilation on study design with application to studies of the ecology conservation and management of wildlife We felt that the need for coverage of study design in one source was strong and although a few books and monographs existed on some of the topics that we covered no single work attempted to synthesize the many facets of wildlife study design We decided to develop this second edition because our original goal synthesis of study design remains strong and because we each gathered a substantial body of new material with which we could update and expand each chapter Several of us also used the first edition as the basis for workshops and graduate teaching which provided us with many valuable suggestions from readers on how to improve the text In particular Morrison received a detailed review from the graduate students in his Wildlife Study Design course at Texas A M University We also paid heed to the reviews of the first edition that appeared in the literature

The Bitterroot Ecosystem Management Research Project ,2000 **Theory of Wildlife Population Ecology** Bruce D. Leopold,2018-10-25 Understanding wildlife population ecology is vital for all wildlife managers and conservation biologists Leopold draws on 30 years of research and teaching experience to give students and natural resource professionals the foundation they need to effectively manage wildlife populations He begins with the key statistical concepts and research approaches necessary to gain insight into various models of population dynamics The many factors that influence wildlife populations are thoroughly explored and their consequences are investigated In addition the author presents techniques for analyzing wildlife harvest data and a lucid discussion of valuable wildlife census methods Frequent examples of foundational literature supplement each chapter with applications of the theories and provide a concise compendium of fundamental concepts of population ecology Abundant statistical exercises reinforce students learning throughout the text

Development of Protocols to Inventory Or Monitor Wildlife, Fish, Or Rare Plants David Vesely,2006 **Endangered Marine Vertebrates - Recent Advances for Conservation** Mohamed Nejmeddine Bradai,Imed Jribi,Bechir Saidi,Samira Enajjar,2025-04-23 The destruction of marine habitats and the marine environment generally results from the cumulative impact of several threats such as fishing bycatch illegal and ghost fishing pollution in all its forms chemical organic and physical and climate change All these threats have contributed to the degradation of the seabed and marine biodiversity Endangered vertebrates are the most affected by these problems This book presents scientific information on the biology and ecology of sea turtles sharks and cetaceans as well as fisheries impact on these endangered species to enhance conservation and management efforts

CRC Handbook of Marine Mammal Medicine Leslie

Dierauf, Frances M.D. Gulland, 2001-06-27 CRC Handbook of Marine Mammal Medicine Second Edition is the only handbook specifically devoted to marine mammal medicine and health With 66 contributors working together to craft 45 scientifically based chapters the text has been completely revised and updated to contain all the latest developments in this field Building upon the solid foundation of the previous edition the contents of this book are light years ahead of the topics presented in the first edition See what's new in the Second Edition Marine mammals as sentinels of ocean health Emerging and resurging diseases Thorough revision of the Immunology chapter Diagnostic imaging chapters to illustrate new techniques Quick reference for venipuncture sites in many marine mammals Unusual mortality events and mass strandings New topics such as a chapter on careers Wider scope of coverage including species outside of the United States and Canada Filled with captivating illustrations and photographs the Handbook guides you through the natural history of cetaceans pinnipeds manatees sea otters and polar bears Prepared in a convenient easy to use format it is designed specifically for use in the field Covering more than 40 topics this one of a kind reference is packed with data The comprehensive compilation of information includes medicine surgery pathology physiology husbandry feeding and housing with special attention to strandings and rehabilitation The CRC Handbook of Marine Mammal Medicine Second Edition is still a must for anyone interested in marine mammals

Thermal Imaging Techniques to Survey and Monitor Animals in the Wild Kirk J Havens, Edward J. Sharp, 2015-09-22 Thermal Imaging Techniques to Survey and Monitor Animals in the Wild A Methodology provides a manual for anyone interested in understanding thermal imaging and its usefulness in solving a wide range of problems regarding the observation of wildlife In the last decade the cost of thermal imaging technology has significantly decreased making the equipment more widely available This book offers an overview of thermal physics and the thermal imager along with a methodology to optimize the window of opportunity so that wildlife can be observed and studied in their natural habitat Users will find the knowledge and tools to formulate a sound survey design with detailed sections on the theory and performance characteristics of thermal imaging cameras utilizing cooled quantum detectors as the sensitive element and additional information on the uncooled micro bolometric imagers which have been introduced into the camera market in past decades The methodology presented is logical and simple yet it presents a detailed understanding of the topic and how it applies to the critically interlinked disciplines of biology physics micrometeorology and animal physiology Covers the technical aspects of thermal imaging allowing readers to design better experiments Provides a clear description of the properties of thermal imaging Includes approaches to consider before integrating thermal cameras into a field

Lizards of the World Gordon H. Rodda, 2020-09-01 The first definitive reference on the natural history and ecology of every one of the known 6500 species of lizards spanning the entire globe Our planet is literally crawling with lizards More than 6500 species are known to science and new species are being discovered annually In this monumental work eminent researcher Gordon Rodda has created the first compilation of the natural histories of all the world's lizards and amphisbaenians as well as the

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Reintroduction of Fish and Wildlife Populations David S. Jachowski, Joshua J. Millspaugh, Paul L. Angermeier, Rob Slotow, 2016-09-13 Reintroduction of Fish and Wildlife Populations provides a practical step by step guide to successfully planning implementing and evaluating the reestablishment of animal populations in former habitats or their introduction in new environments In each chapter experts in reintroduction biology outline a comprehensive synthesis of core concepts issues techniques and perspectives This manual and reference supports scientists and managers from fisheries and wildlife professions as they plan reintroductions initiate releases of individuals and manage restored populations over time Covering a broad range of taxonomic groups ecosystems and global regions this edited volume is an essential guide for academics students and professionals in natural resource management

Demographic Methods Across the Tree of Life Roberto Salguero-Gómez, Marlène Gamelon, 2021 This novel book provides the reader with the fundamentals of data collection model construction analyses and interpretation across a wide repertoire of demographic techniques and protocols clearly guided throughout with fully reproducible R scripts

Sampling Rare or Elusive Species William Thompson, 2013-04-10 Information regarding population status and abundance of rare species plays a key role in resource management decisions Ideally data should be collected using statistically sound sampling methods but by their very nature rare or elusive species pose a difficult sampling challenge *Sampling Rare or Elusive Species* describes the latest sampling designs and survey methods for reliably estimating occupancy abundance and other population parameters of rare elusive or otherwise hard to detect plants and animals It offers a mixture of theory and application with actual examples from terrestrial aquatic and marine habitats around the world *Sampling Rare or Elusive Species* is the first volume devoted entirely to this topic and provides natural resource professionals with a suite of innovative approaches to gathering population status and trend data It represents an invaluable reference for natural resource professionals around the world including fish and wildlife biologists ecologists biometricians

natural resource managers and all others whose work or research involves rare or elusive species The Allegheny Woodrat John Peles, Janet Wright, 2008-07-20 A decline in populations of Allegheny woodrats *Neotoma magister* was first noticed in the 1980s Since that time woodrats have become extirpated from at least two states and have declined dramatically in several others Recent evidence suggests that the decline of this species may be proceeding further south to include states where woodrat populations were previously considered to be stable The Allegheny Woodrat Ecology Conservation and Management of a Declining Species provides a comprehensive summary of research conducted over the past twenty five years The book integrates the results of this research into a comprehensive picture of the ecological requirements conservation principles and management strategies for this declining species In addition general principles learned from the study of woodrats are applied to the conservation and management of other declining species including other species of *Neotoma* The editors and chapter authors are researchers from both academic settings and state management agencies individuals who have contributed significantly to the study of Allegheny woodrats during the past two decades The book will be of interest to ecologists conservation biologists wildlife professionals and students *Guide to Reference and Information Sources in the Zoological Sciences* Diane Schmidt, 2003-11-30 Animals have been studied for centuries But what are the most important and relevant reference and information sources in the zoological sciences This work is a comprehensive thoroughly annotated directory filled with hundreds of esteemed resources published in the field of zoology including indexes abstracts bibliographies journals biographies and histories dictionaries and encyclopedias textbooks checklists and classification schemes handbooks and field guides associations and Web sites A complete revision of the award winning Guide to the Zoological Literature The Animal Kingdom 1994 this new title includes extensive up to date coverage of invertebrates arthropods vertebrates fishes amphibians and reptiles birds and mammals In addition the work features a detailed introduction by the author as well as thorough subject title and author indexes Students and researchers can now quickly and easily pinpoint works in their field of study The book is of equal importance to LIS students specializing in science or biology librarianship as it provides a comprehensive straight forward overview of zoological information sources An essential addition to the core reference collection of public and academic libraries **The Wildlife Techniques Manual** Nova J. Silvy, 2020-07-28 The 1 selling wildlife management book for 40 years now updated for the next generation of professionals and students Since its original publication in 1960 The Wildlife Techniques Manual has remained the cornerstone text for the professional wildlife biologist Now fully revised and updated this eighth edition promises to be the most comprehensive resource on wildlife biology conservation and management for years to come Superbly edited by Nova J Silvy and published in association with The Wildlife Society the 50 authoritative chapters included in this work provide a full synthesis of methods used in the field and laboratory Chapter authors all leading wildlife professionals explain and critique traditional and new methodologies and offer thorough discussions of a wide range of relevant topics To effectively incorporate the

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Demography John R. Skalski, Kristin E. Ryding, Joshua Millspaugh, 2010-07-20 Wildlife Demography compiles the multitude of available estimation techniques based on sex and age data and presents these varying techniques in one organized unified volume Designed to guide researchers to the most appropriate estimator based upon their particular data set and the desired level of study precision this book provides quantitative consideration statistical models estimator variance assumptions and examples of use The authors focus on estimation techniques using sex and age ratios because this data is relatively easy to collect and commonly used by wildlife management Applicable to a wide array of wildlife species including game and non game birds and mammals Features more than 100 annotated examples illustrating application of statistical methods Includes more than 640 references of the analysis of nontagging data and the factors that may influence interpretation Derives historical and ad hoc demographic methods in a modern statistical framework Connecting Mountain Islands and Desert Seas, 2005

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