

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.

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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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Monitoring Vertebrate Populations

**William L. Thompson, Gary C.
White, Charles Gowan**



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 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.

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.

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 **Proceedings RMRS**, 1998

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.

Development of Protocols to Inventory Or Monitor Wildlife, Fish, Or Rare Plants David Vesely, 2006

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.

Effective Monitoring to

Evaluate Ecological Restoration in the Gulf of Mexico National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies, Water Science and Technology Board, Ocean Studies Board, Committee on Effective Approaches for Monitoring and Assessing Gulf of Mexico Restoration Activities, 2017-03-16 Gulf Coast communities and natural resources suffered extensive direct and indirect damage as a result of the largest accidental oil spill in US history referred to as the Deepwater Horizon DWH oil spill. Notably, natural resources affected by this major spill include wetlands, coastal beaches and barrier islands, coastal and marine wildlife, seagrass beds, oyster reefs, commercial fisheries, deep benthos, and coral reefs among other habitats and species. Losses include an estimated 20% reduction in commercial fishery landings across the Gulf of Mexico and damage to as much as 1,100 linear miles of coastal salt marsh wetlands. This historic spill is being followed by a restoration effort unparalleled in complexity and magnitude in US history. Legal settlements in the wake of DWH led to the establishment of a set of programs tasked with administering and supporting DWH-related restoration in the Gulf of Mexico. In order to ensure that restoration goals are met and money is well spent, restoration monitoring and evaluation should be an integral part of those programs. However, evaluations of past restoration efforts have shown that monitoring is often inadequate or even absent. *Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico* identifies best practices for monitoring and evaluating restoration activities to improve the performance of restoration programs and increase the effectiveness and longevity of restoration projects. This report provides general guidance for restoration monitoring, assessment, and synthesis that can be applied to most ecological restoration supported by these major programs given their similarities in restoration goals. It also offers specific guidance for a subset of habitats and taxa to be restored in the Gulf, including oyster reefs, tidal wetlands, and seagrass habitats, as well as a variety of birds, sea turtles, and marine mammals.

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 Tuatara. Although other books have attempted to survey the scope of adaptations present in the world's lizards, only Rodda has been able to quantify and summarize all species or higher taxa. Analyzing the relationships among traits such as morphologic characteristics, reproductive strategies, and food sources, Rodda uncovers novel insights into reptile ecology. Identifying 14 recurring character syndromes across all the world's lizards, he proposes a new lens for categorization. He also touches on common names, geographic range, length, mass, age, maturation differences between the sexes, nominal variables including diel activity cycle and foraging mode, home range, predator avoidance tactics, thermal biology, social spacing, climate envelope, habitat, and microhabitat, reproduction, parental care, diet, population density, conservation status, ecological business models. Rodda's alphabetical taxon accounts provide an instantly retrievable sketch of

every species genus and family Outlining more than 1500 statistically significant associations extracted from a data matrix composed of more than 300 conditions tabulated to the extent known for all 6528 species of lizards Lizards of the World will be the go to source for the next generation of reptile ecologists as well as herpetology students and serious herpetoculturists

Reintroduction of Fish and Wildlife Populations David S. Jachowski, Joshua J. Millsbaugh, 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

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

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

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 explosion of new information in the wildlife profession this latest edition is logically organized into a 2 volume set Volume 1 is devoted to research techniques and Volume 2 focuses on pragmatic management methodologies Volume 1 describes research design and proper analytic methods prior to conducting research as well as methods and considerations for capturing and handling wild animals and information on identification and marking of captured animals It also includes new chapters on nutritional research and field sign identification and on emerging topics including structured decision making Finally Volume 1 addresses measurements of wildlife abundance and habitat and research on individual animals Volume 2 begins with a section on the relationship

between research and management including public outreach described in a context that encourages engagement prior to initiation of management An adaptive management approach is described as a cornerstone of natural resource management followed by a section on managing landscapes and wildlife populations The volume also includes new chapters on ethics in wildlife science and conservation conflict resolution and management and land reclamation A standard text in a variety of courses the Techniques Manual as it is commonly called covers every aspect of modern wildlife management and provides practical information for applying the hundreds of methods described in its pages This deft and thorough update ensures that The Wildlife Techniques Manual will remain an indispensable resource one that professionals and students in wildlife biology conservation and management simply cannot do without

Wildlife 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 **Occupancy Estimation and Modeling** Darryl I. MacKenzie, 2006 Publisher Description

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