The Ecological Detective Confronting Models With Data

In this book, we consider three questions. What are ecological models? How are they tested? How do ecological models inform environmental policy and politics? Through several case studies, we see how these representations which idealize and abstract can be used to explain and predict complicated ecological systems. Additionally, we see how they bear on environmental policy and politics.

Ecologists and natural resource managers are charged with making complex management decisions in the face of a rapidly changing environment resulting from climate change, energy development, urban sprawl, invasive species and globalization. Advances in Geographic Information System (GIS) technology, digitization, online data availability, historic legacy datasets, remote sensors and the ability to collect data on animal movements via satellite and GPS have given rise to large, highly complex datasets. These datasets could be utilized for making critical management decisions, but are often “ messy ” and difficult to interpret. Basic artificial intelligence algorithms (i.e., machine learning) are powerful tools that are shaping the world and must be taken advantage of in the life sciences. In ecology, machine learning algorithms are critical to helping resource managers synthesize information to better understand complex ecological systems. Machine Learning has a wide variety of powerful applications, with three general uses that are of particular interest to ecologists: (1) data exploration to gain system knowledge and generate new hypotheses, (2) predicting ecological patterns in space and time, and (3) pattern recognition for ecological sampling. Machine learning can be used to make predictive assessments even when relationships between variables are poorly understood. When traditional techniques fail to capture the relationship between variables, effective use of machine learning can unearth and capture previously unattainable insights into an ecosystem's complexity. Currently, many ecologists do not utilize machine learning as a part of the scientific process. This volume highlights how machine learning techniques can complement the traditional methodologies currently applied in this field.

Bayesian modeling has become an indispensable tool for ecological research because it is uniquely suited to deal with complexity in a statistically coherent way. This textbook provides a comprehensive and accessible introduction to the latest Bayesian methods—in language ecologists can understand. Unlike other books on the subject, this one emphasizes the principles behind the computations, giving ecologists a big-picture understanding of how to implement this powerful statistical approach. Bayesian Models is an essential primer for non-statisticians. It begins with a definition of probability and develops a step-by-step sequence of connected ideas, including basic distribution theory, network diagrams, hierarchical models, Markov chain Monte Carlo, and inference from single and multiple models. This unique book places less emphasis on computer coding, favoring instead a concise presentation of the mathematical statistics needed to understand how and why Bayesian analysis works. It also explains how to write out properly formulated hierarchical Bayesian models and use them in computing, research papers, and proposals. This primer enables ecologists to understand the statistical principles behind Bayesian modeling and apply them to research, teaching, policy, and management. Presents the mathematical and statistical

foundations of Bayesian modeling in language accessible to non-statisticians Covers basic distribution theory, network diagrams, hierarchical models, Markov chain Monte Carlo, and more Deemphasizes computer coding in favor of basic principles Explains how to write out properly factored statistical expressions representing Bayesian models

This book really began in 1980 with our first microcomputer, an Apple II +. The great value of the Apple II + was that we could take the computer programs we had been building on mainframe and mini-computers, and make them available to the many fisheries biologists who also had Apple II + 's. About 6 months after we got our first Apple, John Glaister came through Vancouver and saw what we were doing and realized that his agency (New South Wales State Fisheries) had the same equipment and could run the same programs. John organized a training course in Australia where we showed about 25 Australian fisheries biologists how to use microcomputers to do many standard fisheries analyses. In the process of organizing this and sub sequent courses we developed a series of lecture notes. Over the last 10 years these notes have evolved into the chapters of this book.

Machine Learning for Ecology and Sustainable Natural Resource Management

What Everyone Needs to Know

Spiders in Ecological Webs

Introduction to Modeling in Wildlife and Resource Conservation

Ecological Modeling for Resource Management

Contemporary Theory and Application

The Ecology of Place

The Ecological DetectiveConfronting Models with Data (MPB-28)Princeton University Press

A discussion of overfishing explores the scientific, political, ethical, and economic issues associated with harvesting the ocean's fish, using case studies of fisheries from around the world to answer the issue's most pressing questions.

This book provides students with the skills to develop their own models for application in conservation biology and wildlife management. Assuming no special mathematical expertise, the computational models used are kept simple and show how to develop models in both spreadsheet and programming language format. Develops thought-provoking applications which emphasize the value of modeling as a learning tool Examines basic descriptive equations, matrix representations, consumer-resources interactions, applications in simulation, scenarios, harvesting, population viability, metapopulation dynamics, disease outbreaks, vegetation stage and state dynamics, habitat suitability assessment, and model selection statistics Includes a wide range of examples relating to birds, fish, plants and large African mammals

Toxic chemicals can exert effects on all levels of the biological hierarchy, from cells to organs to organisms to populations to entire ecosystems. However, most risk assessment models express their results in terms of effects on individual organisms, without corresponding information on how populations, groups of species, or whole ecosystems may respond to chemical stressors. Ecological Modeling in Risk Assessment: Chemical Effects on Populations, Ecosystems, and Landscapes takes a new approach by compiling and evaluating

models that can be used in assessing risk at the population, ecosystem, and landscape levels. The authors give an overview of the current process of ecological risk assessment for toxic chemicals and of how modeling of populations, ecosystems, and landscapes could improve the status quo. They present a classification of ecological models and explain the differences between population, ecosystem, landscape, and toxicity-extrapolation models. The authors describe the model evaluation process and define evaluation criteria. Finally, the results of the model evaluations are presented in a concise format with recommendations on modeling approaches to use now and develop further. The authors present and evaluate various models on the basis of their realism and complexity, prediction of relevant assessment endpoints, treatment of uncertainty, regulatory acceptance, resource efficiency, and other criteria. They provide models that will improve the ecological relevance of risk assessments and make data collection more cost-effective. Ecological Modeling in Risk Assessment serves as a reference for selecting and applying the best models when performing a risk assessment.

Ecological Models

Model Selection and Multimodel Inference

Concepts and Applications

Fundamentals of Tree Ring Research

Real World Ecology

Confronting Models with Data (MPB-28)

Experimental Ecology

This module, which examines El Nino and its impact on the Peruvian anchovy fishery, includes study questions and answers, as well as a computer game that allows students to test the impacts of economic and climatic variables on the fish population.

Quantitative models are crucial to almost every area of ecosystem science. They provide a logical structure that guides and informs empirical observations of ecosystem processes. They play a particularly crucial role in synthesizing and integrating our understanding of the immense diversity of ecosystem structure and function. Increasingly, models are being called on to predict the effects of human actions on natural ecosystems. Despite the widespread use of models, there exists intense debate within the field over a wide range of practical and philosophical issues pertaining to quantitative modeling. This book--which grew out of a gathering of leading experts at the ninth Cary Conference--explores those issues. The book opens with an overview of the status and role of modeling in ecosystem science, including perspectives on the long-running debate over the appropriate level of complexity in models. This is followed by eight chapters that address the critical issue of evaluating ecosystem models, including methods of addressing uncertainty. Next come several case studies of the role of models in environmental policy and management. A section on the future of modeling in ecosystem science focuses on increasing the use of modeling in undergraduate education and the modeling skills of professionals within the field. The benefits and limitations of predictive (versus observational) models are also considered in detail. Written by stellar contributors, this book grants access to the state of the art and science of ecosystem

modeling.

From controlling disease outbreaks to predicting heart attacks, dynamic models are increasingly crucial for understanding biological processes. Many universities are starting undergraduate programs in computational biology to introduce students to this rapidly growing field. In Dynamic Models in Biology, the first text on dynamic models specifically written for undergraduate students in the biological sciences, ecologist Stephen Ellner and mathematician John Guckenheimer teach students how to understand, build, and use dynamic models in biology. Developed from a course taught by Ellner and Guckenheimer at Cornell University, the book is organized around biological applications, with mathematics and computing developed through case studies at the molecular, cellular, and population levels. The authors cover both simple analytic models--the sort usually found in mathematical biology texts--and the complex computational models now used by both biologists and mathematicians. Linked to a Web site with computer-lab materials and exercises, Dynamic Models in Biology is a major new introduction to dynamic models for students in the biological sciences, mathematics, and engineering.

Mathematical Models is a component of Encyclopedia of Mathematical Sciences in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. The Theme on Mathematical Models discusses matters of great relevance to our world such as: Basic Principles of Mathematical Modeling; Mathematical Models in Water Sciences; Mathematical Models in Energy Sciences; Mathematical Models of Climate and Global Change; Infiltration and Ponding; Mathematical Models of Biology; Mathematical Models in Medicine and Public Health; Mathematical Models of Society and Development. These three volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, managers, and decision makers and NGOs.

Inferring Patterns and Dynamics of Species Occurrence

An Experimental Field Approach

Proceedings of a Workshop

Scaling in Ecology with a Model System

El Niño and the Peruvian Anchovy Fishery

Quantitative Methods for Ecology and Evolutionary Biology

Multivariate Analysis of Ecological Data

A groundbreaking approach to scale and scaling in ecological theory and practice Scale is one of the most important concepts in ecology, yet researchers often find it difficult to find ecological systems that lend themselves to its study. Scaling in Ecology with a Model System synthesizes nearly three decades of research on the ecology of Sarracenia purpurea—the northern pitcher plant—showing how this carnivorous plant and its associated food web of microbes and macrobes can inform the challenging question of scaling in ecology. Drawing on a wealth of findings from their pioneering lab and field experiments, Aaron Ellison and Nicholas Gotelli reveal how the Sarracenia microecosystem has emerged as a model system

for experimental ecology. Ellison and Gotelli examine Sarracenia at a hierarchy of spatial scales—individual pitchers within plants, plants within bogs, and bogs within landscapes—and demonstrate how pitcher plants can serve as replicate miniature ecosystems that can be studied in wetlands throughout the United States and Canada. They show how research on the Sarracenia microecosystem proceeds much more rapidly than studies of larger, more slowly changing ecosystems such as forests, grasslands, lakes, or streams, which are more difficult to replicate and experimentally manipulate. Scaling in Ecology with a Model System offers new insights into ecophysiology and stoichiometry, demography, extinction risk and species distribution models, food webs and trophic dynamics, and tipping points and regime shifts.

Seeing Green is the stunning conclusion to this smart, three-book case and brings Nancy and company back to River Heights, where they continue to investigate Green Solutions, the shady American company that is defrauding Casa Verde.

Tree-ring dating (dendrochronology) is a method of scientific dating based on the analysis of tree-ring growth patterns. As author James Speer notes, trees are remarkable bioindicators. Although there are other scientific means of dating climatic and environmental events, dendrochronology provides the most reliable of all paleorecords. Dendrochronology can be applied to very old trees to provide long-term records of past temperature, rainfall, fire, insect outbreaks, landslides, hurricanes, and ice storms--to name only a few events. This comprehensive text addresses all of the subjects that a reader who is new to the field will need to know and will be a welcome reference for practitioners at all levels. It includes a history of the discipline, biological and ecological background, principles of the field, basic scientific information on the structure and growth of trees, the complete range of dendrochronology methods, and a full description of each of the relevant subdisciplines. Individual chapters address the composition of wood, methods of field and laboratory study, dendroarchaeology, dendroclimatology, dendroecology, dendrogeomorphology, and dendrochemistry. The book also provides thorough introductions to common computer programs and methods of statistical analysis. In the final chapter, the author describes "frontiers in dendrochronology," with an eye toward future directions in the field. He concludes with several useful appendixes, including a listing of tree and shrub species that have been used successfully by dendrochronologists. Throughout, photographs and illustrations visually represent the state of knowledge in the field.

Individual-based models are an exciting and widely used new tool for ecology. These computational models allow scientists to explore the mechanisms through which population and ecosystem ecology arises from how individuals interact with each other and their environment. This book provides the first in-depth treatment of individual-based modeling and its use to develop theoretical understanding of how ecological systems work, an approach the authors call "individual-based ecology.? Grimm and Railsback start with a general primer on modeling: how to design models that are as simple as possible while still allowing specific problems to be solved, and how to move efficiently through a cycle of pattern-oriented model design, implementation, and analysis. Next, they address the problems of theory and conceptual framework for individual-based ecology: What is "theory"? That is, how do we develop reusable models of how system dynamics arise from characteristics of individuals? What conceptual framework do we use when the classical differential equation framework no longer applies? An extensive review illustrates the ecological problems that have been addressed with individual-based

models. The authors then identify how the mechanics of building and using individual-based models differ from those of traditional science, and provide guidance on formulating, programming, and analyzing models. This book will be helpful to ecologists interested in modeling, and to other scientists interested in agent-based modeling.

Models in Ecosystem Science

A Practical Information-Theoretic Approach

Bayesian Models

Simulation Modeling of Forest Landscape Disturbances

Vertebrate Zoology

The Ecological Detective

Choice, Dynamics and Uncertainty

Forest landscape disturbances are a global phenomenon. Simulation models are an important tool in understanding these broad scale processes and exploring their effects on forest ecosystems. This book contains a collection of insights from a group of ecologists who address a variety of processes: physical disturbances such as drought, wind, and fire; biological disturbances such as defoliating insects and bark beetles; anthropogenic influences; interactions among disturbances; effects of climate change on disturbances; and the recovery of forest landscapes from disturbances—all from a simulation modeling perspective. These discussions and examples offer a broad synopsis of the state of this rapidly evolving subject.

Making statistical modeling and inference more accessible to ecologists and related scientists, Introduction to Hierarchical Bayesian Modeling for Ecological Data gives readers a flexible and effective framework to learn about complex ecological processes from various sources of data. It also helps readers get started on building their own statisti

Mathematical modelling is widely used in ecology and evolutionary biology and it is a topic that many biologists find difficult to grasp. In this new textbook Marc Mangel provides a no-nonsense introduction to the skills needed to understand the principles of theoretical and mathematical biology. Fundamental theories and applications are introduced using numerous examples from current biological research, complete with illustrations to highlight key points. Exercises are also included throughout the text to show how theory can be applied and to test knowledge gained so far. Suitable for advanced undergraduate courses in theoretical and mathematical biology, this book forms an essential resource for anyone wanting to gain an understanding of theoretical ecology and evolution.

The last decade has seen countless advances in the measurement and interpretation of the impacts of environmental heterogeneity upon organisms and ecological processes. Progress has been made at a variety of scales of organisation. Following a Symposium on

Ecological Consequences of Environmental Heterogeneity, a team of international experts has collaborated to produce this volume. It discusses the effects of environmental heterogeneity; the effects of spatial and temporal heterogeneity on individuals, populations, communities and biodiversity; and the management and conservation implications of environment heterogeneity. This book will prove to be an invaluable reference work not only to advanced students but also established researchers working in the field.

Ecological Modeling in Risk Assessment

Critical Approaches and Selected Methodologies

Confronting Models with Data

Modeling in Natural Resource Management

Ecological Statistics

A Statistical Primer for Ecologists

40th Symposium of the British Ecological Society

The interest in using Bayesian methods in ecology is increasing, however many ecologists have difficulty with conducting the required analyses. McCarthy bridges that gap, using a clear and accessible style. The text also incorporates case studies to demonstrate mark-recapture analysis, development of population models and the use of subjective judgement. The advantages of Bayesian methods, are also described here, for example, the incorporation of any relevant prior information and the ability to assess the evidence in favour of competing hypotheses. Free software is available as well as an accompanying web-site containing the data files and WinBUGS codes. Bayesian Methods for Ecology will appeal to academic researchers, upper undergraduate and graduate students of Ecology.

The National Research Council's (NRC) Board on Agriculture and Natural Resources invited professional societies associated with agriculture and ecology to participate in a two-day workshop to explore leadership and a common vision for ecologically based pest management (EBPM). These proceedings describe the challenges of and opportunities for EBPM discussed by participants in the workshop.

Students of ecology at all stages of their careers will find this book a valuable source of ideas and perspectives.

Ecologists can spend a lifetime researching a small patch of the earth, studying the interactions between organisms and the environment, and exploring the roles those interactions play in determining distribution, abundance, and evolutionary change. With so few ecologists and so many systems to study, generalizations are essential. But how do you extrapolate knowledge about a well-studied area and apply it elsewhere? Through a range of original essays written by eminent ecologists and naturalists, The Ecology of Place explores how place-focused research yields exportable general knowledge as well as practical local knowledge, and how society

can facilitate ecological understanding by investing in field sites, place-centered databases, interdisciplinary collaborations, and field-oriented education programs that emphasize natural history. This unique patchwork of case-study narratives, philosophical musings, and historical analyses is tied together with commentaries from editors Ian Billick and Mary Price that develop and synthesize common threads. The result is a unique volume rich with all-too-rare insights into how science is actually done, as told by scientists themselves.

The Ecological Consequences of Environmental Heterogeneity

Ocean Recovery

Individual-based Modeling and Ecology

Large-Scale and Long-Term Case Studies and Methods

Contributions of Place-Based Research to Ecological Understanding

Predictive Species and Habitat Modeling in Landscape Ecology

Quantitative Fisheries Stock Assessment

This volume describes and discusses some of the intricacies associated with qualitative research in this post-modern era. It is the second of a two-volume set. It strives to define terms, identifies paradigms, methodologies and approaches that are applicable to novice and expert researchers alike. The book pays special attention to the biographies of those individuals who have helped to shape and develop these methodologies or research designs. In addition, consideration is given to historical and political underpinnings that relate to the development of qualitative research methodologies. Each research design is described in detail and the similarities and differences among them are explored. This volume makes use of a contextual approach to research and features interviews with scholars who have assisted in developing such methodologies. Of interest are numerous features such as questions for further study and annotated bibliographies that extend the scope of each of the methodologies described.

Ecological Models and Data in R is the first truly practical introduction to modern statistical methods for ecology. In step-by-step detail, the book teaches ecology graduate students and researchers everything they need to know in order to use maximum likelihood, information-theoretic, and Bayesian techniques to analyze their own data using the programming language R. Drawing on extensive experience teaching these techniques to graduate students in ecology, Benjamin Bolker shows how to choose among and construct statistical models for data, estimate their parameters and confidence limits, and interpret the results. The book also covers statistical frameworks, the philosophy of statistical modeling, and critical mathematical functions and probability distributions. It requires no programming background--only basic calculus and statistics. Practical, beginner-friendly introduction to modern

statistical techniques for ecology using the programming language R Step-by-step instructions for fitting models to messy, real-world data Balanced view of different statistical approaches Wide coverage of techniques--from simple (distribution fitting) to complex (state-space modeling) Techniques for data manipulation and graphical display Companion Web site with data and R code for all examples This book was developed from a workshop on the "Effective Use of Ecological Modeling in Management," held in Oak Ridge, Tennessee, on October 23–26, 2000. The workshop was sponsored by the Department of Defense's (DoD's) Strategic Environmental Research and Development Program (SERDP), the Army Research Of?ce, and the Engineering Research and Development Center of the Corps of Engineers as well as by the U. S. Department of Agriculture (USDA) Forest Service. It was hosted by the Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL). The organizing committee for the workshop included senior s- entists from ORNL,the USDA Forest Service,and the U. S. Army Corps of Engineers (ACE). The members of the steering committee were John Barko,Paul Bradford,Bill Goran,Jeff Holland,Russell Harmon,and Mike Vasievich. They helped guide the workshop to a useful product by sugge- ing topics, speakers, and participants. Workshop attendees included senior ecological modelers within the Forest Service,DoD,other federal and state agencies, universities, and the private sector together with ecologic- resource managers in the Forest Service, DoD, and other government and nongovernment agencies and organizations. The book never could have come to fruition without the dedicated efforts of Fred O'Hara in editing each of the chapters and making sure that the text was complete and accurate and that standard methods of expression and design were used in the text, references, tables, and ?gures. His careful attention to the details and to effective communication is appreciated. Many people helped in bringing the book to completion.

An intermediate level text covering foundational ideas in statistics and their ecological application, including generalized linear and generalized mixed-effect models, as well as models allowing for mixtures, spatial or phylogenetic correlations, missing or censored data, and observational data; implemented in R and set within a contemporary research framework.

Issues and Perspectives

Book Three in the Eco Mystery Trilogy

Occupancy Estimation and Modeling

Overfishing

Introduction to Hierarchical Bayesian Modeling for Ecological Data

Development, Interpretation, and Application

Dynamic Modeling in Behavioral Ecology

Ecological and environmental research has increased in scope and complexity in

the last few decades, from simple systems with a few managed variables to complex ecosystems with many uncontrolled variables. These issues encompass problems that are inadequately addressed using the types of carefully controlled experiments that dominate past ecological research. Contemporary challenges facing ecologists include whole ecosystem responses to planned restoration activities and ecosystem modifications, as well as unplanned catastrophic events such as biological invasions, natural disasters, and global climate changes. Major perturbations implicated in large-scale ecological alterations share important characteristics that challenge traditional experimental design and statistical analyses. These include: * Lack of randomization, replication and independence * Multiple scales of spatial and temporal variability * Complex interactions and system feedbacks. In real world ecology, standard replicated designs are often neither practical nor feasible for large-scale experiments, yet ecologists continue to cling to these same standard designs and related statistical analyses. Case studies that fully elucidate the currently available techniques for conducting large-scale unreplicated analyses are lacking. Real World Ecology: Large-Scale and Long-Term Case Studies and Methods is the first to focus on case studies to demonstrate how ecologists can investigate complex contemporary problems using new and powerful experimental approaches. This collection of case studies showcases innovative experimental designs, analytical options, and interpretation possibilities currently available to theoretical and applied ecologists, practitioners, and biostatisticians. By illustrating how scientists have answered pressing questions about ecosystem restoration, impact and recovery, global warming, conservation, modeling, and biological invasions, this book will broaden the acceptance and application of modern approaches by scientists and encourage further methodological development.

The natural environment is so complex that simplification through abstraction is necessary to communicate concepts and relationships, to comprehend possible reactions, and to decide upon a course of action for management. Today, nearly every decision concerning the management of natural resources is based on a model of one kind or another. Modeling in Natural Resource Management offers a much-needed overview of the basic principles for understanding and evaluating models. Focusing on the fundamental components of model creation, interpretation, and application, the book provides a wealth of information on how models are developed and used in natural resource management, as it: defines what models are explores how the different classes of models fit into the scientific process discusses how to determine the appropriateness and usefulness of a particular model provides examples of how models are used (and misused) considers how further progress might be achieved Chapters written by leading experts -- including Mark S. Boyce, William T. Clark, Michael J. Conroy, Donald L. DeAngelis, Douglas H. Johnson, William L. Kendall, Lyman L. McDonald, Marc Mangel, James D. Nichols, Gary C. White, and others -- describe how models should be constructed and interpreted, and highlight how they can be and have

been used. Modeling in Natural Resource Management brings together in a single volume the best and most current information about natural resource modeling and its on-the-ground application, providing a valuable reference both for scientists involved with issues of natural resource management and for managers who apply the science to real-world problems.

This is a major new textbook that is intended to lead students away from purely descriptive zoology courses into an experimental approach that emphasizes asking and answering questions about nature. The book gives a panoramic view of vertebrate life, classification, ecology and behaviour. Section I of the book describes the major groups of vertebrates and their origins. The second section covers classification and its methodology. Section III describes the ecology of vertebrates from two standpoints: how individuals cope with environmental extremes, and principles of population and community ecology as illustrated by experiments carried out in the field. Section IV describes the geographic distribution of vertebrates. The fifth section discusses migration. Vertebrate behaviour is the subject of the final section and covers observations and the theories and experiments they have inspired.

The modern ecologist usually works in both the field and laboratory, uses statistics and computers, and often works with ecological concepts that are model-based, if not model-driven. How do we make the field and laboratory coherent? How do we link models and data? How do we use statistics to help experimentation? How do we integrate modeling and statistics? How do we confront multiple hypotheses with data and assign degrees of belief to different hypotheses? How do we deal with time series (in which data are linked from one measurement to the next) or put multiple sources of data into one inferential framework? These are the kinds of questions asked and answered by The Ecological Detective. Ray Hilborn and Marc Mangel investigate ecological data much as a detective would investigate a crime scene by trying different hypotheses until a coherent picture emerges. The book is not a set of pat statistical procedures but rather an approach. The Ecological Detective makes liberal use of computer programming for the generation of hypotheses, exploration of data, and the comparison of different models. The authors' attitude is one of exploration, both statistical and graphical. The background required is minimal, so that students with an undergraduate course in statistics and ecology can profitably add this work to their tool-kit for solving ecological problems.

A Sustainable Future for Global Fisheries?

Ecological Models and Data in R

The Theoretical Biologist's Toolbox

Professional Societies and Ecologically Based Pest Management

Seeing Green

Dynamic Models in Biology

Over the last two decades, the scientific and popular media have been

bombarded by gloom and doom stories of the future of fisheries, the status of fish stocks, and the impact of fishing on marine ecosystems. Dozens of certification and labeling schemes have emerged to advise consumers on what seafood is sustainable. In recent years, an opposing narrative has emerged emphasizing the success of fisheries management in many places, the increasing abundance of fish stocks in those places, and the prescription for sustainable fisheries. However, there has been no comprehensive survey of what really constitutes sustainability in fisheries, fish stock status, success and failures of management, and consideration of the impacts of fishing on marine ecosystems. This book will explore very different perspectives on sustainability, and bring together the data from a large number of studies to show where fish stocks are increasing, where they are declining, the consequences of alternative fisheries management regimes, and what is known about a range of fisheries issues such as the impacts of trawling on marine ecosystems. Ocean Recovery is aimed principally at a general audience that is already interested in fisheries but seeks both a deeper understanding of what is known about specific issues and an impartial presentation of all the data rather than selected examples used to justify a particular perspective or agenda. It will also appeal to the scientific community eager to know more about marine fisheries and fishing data, and serve as the basis for graduate seminars on the sustainability of natural resources.
This book describes a powerful and flexible technique for the modeling of behavior, based on evolutionary principles. The technique employs stochastic dynamic programming and permits the analysis of behavioral adaptations wherein organisms respond to changes in their environment and in their own current physiological state. Models can be constructed to reflect sequential decisions concerned simultaneously with foraging, reproduction, predator avoidance, and other activities. The authors show how to construct and use dynamic behavioral models. Part I covers the mathematical background and computer programming, and then uses a paradigm of foraging under risk of predation to exemplify the general modeling technique. Part II consists of five "applied" chapters illustrating the scope of the dynamic modeling approach. They treat hunting behavior in lions, reproduction in insects, migrations of aquatic organisms, clutch size and parental care in birds, and movement of spiders and raptors. Advanced topics, including the study of dynamic evolutionarily stable strategies, are discussed in Part III.
Publisher Description
A unique and comprehensive text on the philosophy of model-based data analysis and strategy for the analysis of empirical data. The book

introduces information theoretic approaches and focuses critical attention on a priori modeling and the selection of a good approximating model that best represents the inference supported by the data. It contains several new approaches to estimating model selection uncertainty and incorporating selection uncertainty into estimates of precision. An array of examples is given to illustrate various technical issues. The text has been written for biologists and statisticians using models for making inferences from empirical data.

Bayesian Methods for Ecology

A Primer of Ecology

Qualitative Research in the Post-Modern Era

MATHEMATICAL MODELS – Volume III

Chemical Effects on Populations, Ecosystems, and Landscapes

A critical evaluation of the role of field experimentation in population and community ecology.

Most projects in Landscape Ecology, at some point, define a species-habitat association. These models are inherently spatial, dealing with landscapes and their configurations. Whether coding behavioral rules for dispersal of simulated organisms through simulated landscapes, or designing the sampling extent of field surveys and experiments in real landscapes, landscape ecologists must make assumptions about how organisms experience and utilize the landscape. These convenient working postulates allow modelers to project the model in time and space, yet rarely are they explicitly considered. The early years of landscape ecology necessarily focused on the evolution of effective data sources, metrics, and statistical approaches that could truly capture the spatial and temporal patterns and processes of interest. Now that these tools are well established, we reflect on the ecological theories that underpin the assumptions commonly made during species distribution modeling and mapping. This is crucial for applying models to questions of global sustainability. Due to the inherent use of GIS for much of this kind of research, and as several authors' research involves the production of multicolored map figures, there would be an 8-page color insert. Additional color figures could be made available through a digital archive, or by cost contributions of the chapter authors. Where applicable, would be relevant chapters' GIS data and model code available through a digital archive. The practice of data and code sharing is becoming standard in GIS studies, is an inherent method of this book, and will serve to add additional research value to the book for both academic and practitioner audiences.

La diversidad biológica es fruto de la interacción entre numerosas especies, ya sean marinas, vegetales o animales, a la par que de los muchos factores limitantes que caracterizan el medio que habitan. El análisis multivariante utiliza las relaciones entre diferentes variables para ordenar los objetos de estudio según sus propiedades colectivas y luego clasificarlos; es decir, agrupar especies o ecosistemas en distintas clases compuestas cada una por entidades con propiedades parecidas. El fin último es relacionar la variabilidad biológica observada con las correspondientes características medioambientales. Multivariate Analysis of Ecological Data explica de manera completa y estructurada cómo analizar e interpretar los datos ecológicos observados sobre múltiples variables, tanto biológicos como medioambientales. Tras una introducción general a los datos ecológicos multivariantes y la metodología estadística, se abordan en capítulos específicos, métodos como aglomeración (clustering), regresión, biplots, escalado multidimensional, análisis de correspondencias (simple y canónico) y análisis log-ratio, con atención también a sus problemas de modelado y aspectos inferenciales. El libro plantea una serie de aplicaciones a datos reales derivados de investigaciones ecológicas, además de dos casos detallados que llevan al lector a apreciar los retos de análisis, interpretación y comunicación inherentes a los estudios a gran escala y los diseños complejos.

Including both simple and more advanced problems, this is a concise but detailed exposition of the most common mathematical models in population and community ecology.