Illustrated Guide To Theoretical Ecology

Community ecology has undergone a transformation in recent years, from a discipline largely focused on processes occurring within a local area to a discipline encompassing a much richer domain of study, including the linkages between communities separated in space (metacommunity dynamics), niche and neutral theory, the interplay between ecology and evolution (eco-evolutionary dynamics), and the influence of historical and regional processes in shaping patterns of biodiversity. To fully understand these new developments, however, students continue to need a strong foundation in the study of species interactions and how these interactions are assembled into food webs and other ecological networks. This new edition fulfils the book's original aims, both as a much-needed up-to-date and accessible introduction to modern community ecology, and in identifying the important questions that are yet to be answered. This research-driven textbook introduces state-of-the-art community ecology to a new generation of students, adopting reasoned and balanced perspectives on as-yet-unresolved issues. Community Ecology is suitable for advanced undergraduates, graduate students, and researchers seeking a broad, up-to-date coverage of ecological concepts at the community level.

All populations fluctuate stochastically, creating a risk of extinction that does not exist in deterministic models, with fundamental consequences for both pure and applied ecology. This book provides the most comprehensive introduction to stochastic population dynamics, combining classicalbackground material with a variety of modern approaches, including new and previously unpublished results by the authors, illustrated with examples from bird and mammal populations, and insect communities.Demographic and environmental stochasticity are introduced with statistical methods for estimating them from field data. The long-run growth rate of a population is explained and extended to include age structure with both deomgraphic and environmental stochasticity. Diffusion approximationsfacilitate the analysis of extinction dynamics and the duration of the final decline. Methods are developed for estimating delayed density dependence from population time series using life history data. Metapopulation viability and the spatial scale of population fluctuations and extinction risk areanalyzed. Stochastic dynamics and statistical uncertainty in population parameters are incorporated in Population Viability Analysis and strategies for sustainable harvesting.Statistics of species diversity measures and species abundance distributions are described, with implications for rapid assessments of biodiversity, and methods are developed for partitioning species diversity into additive components. Analysis of the stochastic dynamics of a tropical butterflycommunity in space and time indicates that most of the variance in the species abundance distribution is due to ecological heterogeneity among species, so that real communities are far from neutral.

Evolutionary Community Ecology develops a unified framework for understanding the structure of ecological communities and the dynamics of natural selection that shape the evolution of the species inhabiting them. All species engage in interactions with many other species, and these interactions regulate their abundance, define their trajectories of natural selection, and shape their movement decisions. Mark McPeek synthesizes the ecological and evolutionary dynamics generated by species interactions that structure local biological communities and regional metacommunities. McPeek explores the ecological performance characteristics needed for invasibility and coexistence of species in complex networks of species interactions. This species interaction framework is then extended to examine the ecological dynamics of natural selection that drive coevolution of interacting species in these complex interaction networks. The models of natural selection resulting from species interactions are used to evaluate the ecological conditions that foster diversification at multiple trophic levels. Analyses show that diversification depends on the ecological context in which species interactions occur and the types of traits that define the mechanisms of those species interactions. Lastly, looking at the mechanisms of speciation that affect species richness and diversity at various spatial scales and the consequences of past climate change over the Quaternary period, McPeek considers how metacommunity structure is shaped at regional and biogeographic scales. Integrating evolutionary theory into the study of community ecology, Evolutionary Community Ecology provides a new framework for predicting how communities are organized and how they may change over time.

An Illustrated Guide to Theoretical EcologyOxford University Press, USA

Fundamental Processes in Ecology presents a way to study ecosystems that is not yet available in ecology textbooks but is resonant with current thinking in the emerging fields of geobiology and Earth System Science. It provides an alternative, process-based classification of ecology and proposes a truly planetary view of ecological science. To achieve this, it asks (and endeavours to answer) the question, "what are the fundamental ecological processes which would be found on any planet with Earth-like, carbon based, life?" The author demonstrates how the idea of fundamental ecological processes can be developed at the systems level, specifically their involvement in control and feedback mechanisms. This approach allows us to reconsider basic ecological ideas such as energy flow, guilds, trade-offs, carbon cycling and photosynthesis; and to put these in a global context. In doing so, the book puts a much stronger emphasis on microorganisms than has traditionally been the case. The integration of Earth System Science with ecology is vitally important if ecological science is to successfully contribute to the massive problems and future challenges associated with global change. Although the approach is heavily influenced by Lovelock's Gaia hypothesis, this is not a popular science book about Gaian theory. Instead it is written as an accessible text for graduate student seminar courses and researchers in the fields of ecology, earth system science, evolutionary biology, palaeontology, history of life, astrobiology, geology and physical geography.

This book presents new approaches to studying food webs, using practical and policy examples to demonstrate the theory behind ecosystem management decisions.

Insects, when studied from the ecological perspective, provide a great opportunity for scientific studies emphasizing population theory. The simple fact of being successful organisms for their ability to colonize different habitats or even for their high reproductive potential, increases the interest of ecologists in conducting studies focused on population and community level. Mathematical models are powerful tools that can capture the essence of many biological systems and investigate ecological patterns associated to ecological stability dependent on endogenous and exogenous factors. This proposal comes from the idea of adding experiences of researchers interested in working at the interface between mathematical and computation theory and problems centered on entomology, showing how mathematical modelling can be an important tool for understanding population dynamics, behavior, pest management, spatial structure and conservation.

Provides simple explanations of the important concepts in population and community ecology. Provides R code throughout, to illustrate model development and analysis, as well as appendix introducing the R language. Interweaves ecological content and code so that either stands alone. Supplemental web site for additional code.

Despite claims to the contrary, the science of ecology has a long history of building theories. Many ecological theories are mathematical, computational, or statistical, though, and rarely have attempts been made to organize or extrapolate these models into broader theories. The Theory of Ecology brings together some of the most respected and creative theoretical ecologists of this era to advance a comprehensive, conceptual articulation of ecological theories. The contributors cover a wide range of topics, from ecological niche theory to population dynamic theory to island biogeography theory. Collectively, the chapters ably demonstrate how theory in ecology accounts for observations about the natural world and how models provide predictive understandings. It organizes these models into constitutive domains that highlight the strengths and weaknesses of ecological understanding. This book is a milestone in ecological theory and is certain to motivate future empirical and theoretical work in one of the most exciting and active domains of the life sciences.

Introduction and background; Exploratory data analysis and graphics; Deterministic functions for ecological modeling; Probability and stochastic distributions for ecological modeling; Stochatsic simulation and power analysis; Likelihood and all that; Optimization and all that; Likelihood examples; Standar statistics revisited; Modeling variance; Dynamic models.

Ecology is in a challenging state as a scientific discipline. While some theoretical ecologists are attempting to build a definition of ecology from first principles, many others are questioning even the feasibility of a general and universal theory. At the same time, it is increasingly important that ecology is accurately and functionally defined for a generation of researchers tackling escalating environmental problems in the face of doubt and disagreement. The authors of Theory-Based Ecology have written a textbook that presents a robust, modern, and mathematically sound theory of ecology, maintaining a strong link between empirical data, models, and theory. It is firmly based in Darwinian thought, since it was Darwin who first revealed the ecological principles of the origin of species, and gave the evolution of diversity a process-based, mechanistic explanation. The authors base their synthetic theory of Darwinian ecology on seven key principles: exponential growth, growth regulation, inherited individual differences, finiteness and stochasticity, competitive exclusion, robust coexistence, and constraints and trade-offs. Within this solid conceptual framework, they integrate classic and actual empirical knowledge from ecology and evolutionary biology, clarifying methodological and mathematical detail in clear and helpful text boxes. A wealth of illustrated examples pertaining to different organisational levels (alleles, clones and species) helps to explain how the principles operate. This is an invaluable resource for graduate level students as well as professional researchers in the fields of ecology, genetics, evolutionary ecology, and mathematical biology.

Leading scientists bring the controversy over Gaia up to date by exploring a broad range of recent thinking on Gaia theory.

Methods in Stream Ecology provies a complete series of field and laboratory protocols in stream ecology that are ideal for teaching or conducting research. This new edition is updated to reflect recent advances in the technology associated with ecological assessment of streams, including remote sensing. In addition, the relationship between stream flow and alluviation has been added, and a new chapter on riparian zones is also included. With a student-friendly price, this Second Edition is key for all students and researchers in stream and freshwater ecology, freshwater biology, marine ecology, and river ecology. This text is also supportive as a supplementary text for courses in watershed ecology/science, hydrology, fluvial geomorphology, and landscape ecology. * Exercises in each chapter * Detailed instructions, illustrations, formulae, and data sheets for in-field research for students * Taxanomic keys to common stream invertebrates and algae * Website with tables * Link from Chapter 22: FISH COMMUNITY COMPOSITION to an interactive program for assessing and modeling fish numbers

Ecological research is becoming increasingly quantitative, yet students often opt out of courses in mathematics and statistics, unwittingly limiting their ability to carry out research in the future. This textbook provides a practical introduction to quantitative ecology for students and practitioners who have realised that they need this opportunity. The text is addressed to readers who haven't used mathematics since school, who were perhaps more confused than enlightened by their undergraduate lectures in statistics and who have never used a computer for much more than word processing and data entry. From this starting point, it slowly but surely instils an understanding of mathematics, statistics and programming, sufficient for initiating research in ecology. The book’s practical value is enhanced by extensive use of biological examples and the computer language R for graphics, programming and data analysis. Key Features: Provides a complete introduction to mathematics statistics and computing for ecologists. Presents a wealth of ecological examples demonstrating the applied relevance of abstract mathematical concepts, showing how a little technique can go a long way in answering interesting ecological questions. Covers elementary topics, including the rules of algebra, logarithms, geometry, calculus, descriptive statistics, probability, hypothesis testing and linear regression. Explores more advanced topics including fractals, non-linear dynamical systems, likelihood and Bayesian estimation, generalised linear, mixed and additive models, and multivariate statistics. R boxes provide step-by-step recipes for implementing the graphical and numerical techniques outlined in each section. How to be a Quantitative Ecologist provides a comprehensive introduction to mathematics, statistics and computing and is the ideal textbook for late undergraduate and postgraduate courses in environmental biology. "With a book like this, there is no excuse for people to be afraid of maths, and to be ignorant of what it can do." —Professor Tim Benton, Faculty of Biological Sciences, University of Leeds, UK

The author walks students through the most common models in ecology, beginning with first principles and then gently making each formulation accessible through a step-by-step development of equations paired with illustrations.".

Mutualisms, interactions between two species that benefit both of them, have long captured the public imagination. Their influence transcends levels of biological organization from cells to populations, communities, and ecosystems. Mutualistic symbioses were crucial to the origin of eukaryotic cells, and perhaps to the invasion of land. Mutualisms occur in every terrestrial and aquatic habitat; indeed, ecologists now believe that almost every species on Earth is involved directly or indirectly in one or more of these interactions. Mutualisms are essential to the reproduction and survival of virtually all organisms, as well as to nutrient cycles in ecosystems. Furthermore, the key ecosystem services that mutualists provide mean that they are increasingly being considered as conservation priorities, ironically at the same time as the acute risks to their ecological and evolutionary persistence are increasingly being identified. This volume, the first general work on mutualism to appear in almost thirty years, provides a detailed and conceptually-oriented overview of the subject. Focusing on a range of ecological and evolutionary aspects over different scales (from individual to ecosystem), the chapters in this book provide expert coverage of our current understanding of mutualism whilst highlighting the most important questions that remain to be answered. In bringing together a diverse team of expert contributors, this novel text captures the excitement of a dynamic field that will help to define its future research agenda.

This major reference is an overview of the current state of theoretical ecology through a series of topical entries centered on both ecological and statistical themes. Coverage ranges across scales—from the physiological, to populations, landscapes, and ecosystems. Entries provide an introduction to broad fields such as Applied Ecology, Behavioral Ecology, Computational Ecology, Ecosystem Ecology, Epidemiology and Epidemic Modeling, Population Ecology, Spatial Ecology and Statistics in Ecology. Others provide greater specificity and depth, including discussions on the Allee effect, ordinary differential equations, and ecosystem services. Descriptions of modern statistical and modeling approaches and how they contributed to advances in theoretical ecology are also included. Succinct, uncompromising, and authoritative—a "must have" for those interested in the use of theory in the ecological sciences.

Thirty years ago, biologists could get by with a rudimentary grasp of mathematics and modeling. Not so today. In seeking to answer fundamental questions about how biological systems function and change over time, the modern biologist is as likely to rely on sophisticated mathematical and computer-based models as traditional fieldwork. In this book, Sarah Otto and Troy Day provide biology students with the tools necessary to both interpret models and to build their own. The book starts at an elementary level of mathematical modeling, assuming that the reader has had high school mathematics and first-year calculus. Otto and Day then gradually build in depth and complexity, from classic models in ecology and evolution to more intricate class-structured and probabilistic models. The authors provide primers with instructive exercises to introduce readers to the more advanced subjects of linear algebra and probability theory. Through examples, they describe how models have been used to understand such topics as the spread of HIV, chaos, the age structure of a country, speciation, and extinction. Ecologists and evolutionary biologists today need enough mathematical training to be able to assess the power and limits of biological models and to develop theories and models themselves. This innovative book will be an indispensable guide to the world of mathematical models for the next generation of biologists. A how-to guide for developing new mathematical models in biology Provides step-by-step recipes for constructing and analyzing models Interesting biological applications Explores classical models in ecology and evolution Questions at the end of every chapter Primers cover important mathematical topics Exercises with answers Appendixes summarize useful rules Labs and advanced material available

A follow-up to the highly successful first edition, this book reviews the manifold ways that scale influences the interpretation of ecological variation. As scale, magnitude, quantity, and measurement occupy an expanding role in ecology, this 2e will be an indispensable addition to individual and institutional libraries. In providing a context for resolution of ecological problems, ecologists will appreciate the significance of scale and magnitude addressed in this book. Written for advanced undergraduates, graduate students, and faculty researchers, this book synthesizes a burgeoning literature on the influences of scale. * Expanded by numerous explanatory figures and wide coverage of material * Topic is of crucial importance to ecologists * The most thorough, complete coverage available on quantitative ecology in the market

Advances in molecular biology, remote sensing, systems biology, bioinformatics, non-linear science, the physics of complex systems and other fields have rendered a great amount of data that remain to be integrated into models and theories that are capable of accounting for the complexity of ecological systems and the evolutionary dynamics of life. It is thus necessary to provide a solid basis to discuss and reflect on these and other challenges both at the local and global scales. This volume aims to delineate an integrative and interdisciplinary view that suggests new avenues in research and teaching, critically discusses the scope of the diverse methods in the study of complex systems, and points at key open questions. Finally, this book will provide students and specialists with a collection of high quality open access essays that will contribute to integrate Ecology, Evolution and Complexity in the context of basic research and in the field of Sustainability Sciences.

A unique monograph describing plant-herbivore interactions in the context of large African herbivorous mammals.

This book is concerned with recent advances in fitness landscapes. The concept of fitness landscapes originates from theoretical biology and refers to a framework for analysing and visualizing the relationships between genotypes, phenotypes and fitness. These relationships lay at the centre of attempts to mathematically describe evolutionary processes and evolutionary dynamics. The book addresses recent advances in the understanding of fitness landscapes in evolutionary biology and evolutionary computation. In the volume, experts in the field of fitness landscapes present these findings in an integrated way to make it accessible to a number of audiences: senior undergraduate and graduate students in computer science, theoretical biology, physics, applied mathematics and engineering, but also researcher looking for a reference or/and entry point into using fitness landscapes for analysing algorithms. Also practitioners wanting to employ fitness landscape techniques for evaluating bio- and nature-inspired computing algorithms can find valuable material in the book. For teaching proposes, the book could also be used as a reference handbook.

When we think about viruses we tend to consider ones that afflict humans—such as those that cause influenza, HIV, and Ebola. Yet, vastly more viruses infect single-celled microbes. Diverse and abundant, microbes and the viruses that infect them are found in oceans, lakes, plants, soil, and animal-associated microbiomes. Taking a vital look at the "microscopic" mode of disease dynamics, Quantitative Viral Ecology establishes a theoretical foundation from which to model and predict the ecological and evolutionary dynamics that result from the interaction between viruses and their microbial hosts. Joshua Weitz addresses three major questions: What are viruses of microbes and what do they do to their hosts? How do interactions of a single virus-host pair affect the number and traits of hosts and virus populations? How do virus-host dynamics emerge in natural environments when interactions take place between many viruses and many hosts? Emphasizing how theory and models can provide answers, Weitz offers a cohesive framework for tackling new challenges in the study of viruses and microbes and how they are connected to ecological processes—from the laboratory to the Earth system. Quantitative Viral Ecology is an innovative exploration of the influence of viruses in our complex natural world.

Fisheries supply a critically important ecosystem service by providing over three billion people with nearly 20% of their daily animal protein intake. Yet one third of the world's fish stocks are currently harvested at unsustainable levels. Calls for the adoption of more holistic approaches to management that incorporate broader ecosystem principles are now being translated into action worldwide to meet this challenge. The transition from concept to implementation is accompanied by the need to further establish and evaluate the analytical framework for Ecosystem-Based Fishery Management (EBFM). The objectives of this novel textbook are to provide an introduction to this topic for the next generation of scientists who will carry on this work, to illuminate the deep and often underappreciated connections between basic ecology and fishery science, and to explore the implications of these linkages in formulating management strategies for the 21st century. Fishery Ecosystem Dynamics will be of great use to graduate level students as well as academic researchers and professionals (both governmental and NGO) in the fields of fisheries ecology and management.

This edited volume in the Theoretical Ecology series addresses the historical development and evolution of theoretical ideas in the field of ecology. Not only does Ecological Paradigms Lost recount the history of the discipline by practitioners of the science of ecology, it includes commentary on these historical reflections by philosophers of science. Even though the theories discussed are, in many cases, are at the forefront of research, the language and approach make this material accessible to non-theoreticians. The book is structured in 5 major sections including population ecology, epidemiology, community ecology, evolutionary biology and ecosystem ecology. In each section a chapter by an eminent, experienced ecologist is complemented by analysis from a newer, cutting-edge researcher. Reflection on the past and future of ecology A historical overview of major ideas in the field of ecology Pairing of historical views by ecologists along with a philosophical commentary directed at the practicing scientists' views by a philosopher of science Historical analysis by practicing ecologists including anectodal experiences that are rarely recorded Based on a very popular symposium at the 2002 Ecological Society of America annual meeting in Tucson, AZ

Food webs have now been addressed in empirical and theoretical research for more than 50 years. Yet, even elementary foundational issues are still hotly debated. One difficulty is that a multitude of processes need to be taken into account to understand the patterns found empirically in the structure of food webs and communities. Food Webs and Biodiversity develops a fresh, comprehensive perspective on food webs. Mechanistic explanations for several known macroecological patterns are derived from a few fundamental concepts, which are quantitatively linked to field-observables. An argument is developed that food webs will often be the key to understanding patterns of biodiversity at community level. Key Features: Predicts generic characteristics of ecological communities in invasion-extirpation equilibrium. Generalizes the theory of competition to food webs with arbitrary topologies. Presents a new, testable quantitative theory for the mechanisms determining species richness in food webs, and other new results. Written by an internationally respected expert in the field. With global warming and other pressures on ecosystems rising, understanding and protecting biodiversity is a cause of international concern. This highly topical book will be of interest to a wide ranging audience, including not only graduate students and practitioners in community and conservation ecology but also the complex-systems research community as well as mathematicians and physicists interested in the theory of networks. "This is a comprehensive work outlining a large array of very novel and potentially game-changing ideas in food web ecology." —Ken Haste Andersen, Technical University of Denmark "I believe that this will be a landmark book in community ecology … it presents a well-established and consistent mathematical theory of food-webs. It is testable in many ways and the author finds remarkable agreements between predictions and reality." —Géza Meszéna, Eötvös University, Budapest

This book provides a unique perspective on the destruction - both natural and human-caused - of coral reef ecosystems. Reconstructing the ecological history of coral reefs, the authors evaluate whether recent dramatic changes are novel events or part of a long-term trend or cycle. The text combines principles of geophysics, paleontology, and marine sciences with real-time observation, examining the interacting causes of change: hurricane damage, predators, disease, rising sea-level, nutrient loading, global warming and ocean acidification. Predictions about the future of coral reefs inspire strategies for restoration and management of ecosystems. Useful for students and professionals in ecology and marine biology, including environmental managers.

A friendly 2007 guide to mathematical modelling for evolutionary and behavioural ecologists.

In contrast with the fundamental ecological expectation that similarity induces competition and loss of species, temporal dynamics allows similar species to co-occur. In fact, the coexistence of similar species contributes significantly to species diversity and could affect ecosystem response to climate change. However, because temporal processes take place over time, they have often been a challenge to document or even to identify. Temporal Dynamics and Ecological Process brings together studies that have met this challenge and present two specific aspects of temporal processes: reproductive scheduling and the stable coexistence of similar species. By using plants to extract general principles, these studies uncover deep ties between temporal niche dynamics and the above central ecological issues, thereby providing a better understanding of what drives temporal processes in nature. Written by leading scientists in the field, this title will be a valuable source of reference to research ecologists and those interested in temporal ecology.

All life is chemical. That fact underpins the developing field of ecological stoichiometry, the study of the balance of chemical elements in ecological interactions. This long-awaited book brings this field into its own as a unifying force in ecology and evolution. Synthesizing a wide range of knowledge, Robert Sterner and Jim Elser show how an understanding of the biochemical deployment of elements in organisms from microbes to metazoa provides the key to making sense of both aquatic and terrestrial ecosystems. After summarizing the chemistry of elements and their relative abundance in Earth's environment, the authors proceed along a line of increasing complexity and scale from molecules to cells, individuals, populations, communities, and ecosystems. The book examines fundamental chemical constraints on ecological phenomena such as competition, herbivory, symbiosis, energy flow in food webs, and organic matter sequestration. In accessible prose and with clear mathematical models, the authors show how ecological stoichiometry can illuminate diverse fields of study, from metabolism to global change. Set to be a classic in the field, Ecological Stoichiometry is an indispensable resource for researchers, instructors, and students of ecology, evolution, physiology, and biogeochemistry. From the foreword by Peter Vitousek: "[T]his book represents a significant milestone in the history of ecology. . . . Love it or argue with it--and I do both--most ecologists will be influenced by the framework developed in this book. . . . There are points to question here, and many more to test . . . And if we are both lucky and good, this questioning and testing will advance our field beyond the level achieved in this book. I can't wait to get on with it."

The major subdisciplines of ecology--population ecology, community ecology, ecosystem ecology, and evolutionary ecology--have diverged increasingly in recent decades. What is critically needed today is an integrated, real-world approach to ecology that reflects the interdependency of biodiversity and ecosystem functioning. From Populations to Ecosystems proposes an innovative theoretical synthesis that will enable us to advance our fundamental understanding of ecological systems and help us to respond to today's emerging global ecological crisis. Michel Loreau begins by explaining how the principles of population dynamics and ecosystem functioning can be merged. He then addresses key issues in the study of biodiversity and ecosystems, such as functional complementarity, food webs, stability and complexity, material cycling, and metacommunities. Loreau describes the most recent theoretical advances that link the properties of individual populations to the aggregate properties of communities, and the properties of functional groups or trophic levels to the functioning of whole ecosystems, placing special emphasis on the relationship between biodiversity and ecosystem functioning. Finally, he turns his attention to the controversial issue of the evolution of entire ecosystems and their properties, laying the theoretical foundations for a genuine evolutionary ecosystem ecology. From Populations to Ecosystems points the way to a much-needed synthesis in ecology, one that offers a fuller understanding of ecosystem processes in the natural world.

Metacommunity ecology links smaller-scale processes that have been the provenance of population and community ecology—such as birth-death processes, species interactions, selection, and stochasticity—with larger-scale issues such as dispersal and habitat heterogeneity. Until now, the field has focused on evaluating the relative importance of distinct processes, with niche-based environmental sorting on one side and neutral-based ecological drift and dispersal limitation on the other. This book moves beyond these artificial categorizations, showing how environmental sorting, dispersal, ecological drift, and other processes influence metacommunity structure simultaneously. Mathew Leibold and Jonathan Chase argue that the relative importance of these processes depends on the characteristics of the organisms, the strengths and types of their interactions, the degree of habitat heterogeneity, the rates of dispersal, and the scale at which the system is observed. Using this synthetic perspective, they explore metacommunity patterns in time and space, including patterns of coexistence, distribution, and diversity. Leibold and Chase demonstrate how these processes and patterns are altered by micro- and macroevolution, traits and phylogenetic relationships, and food web interactions. They then use this scale-explicit perspective to illustrate how metacommunity processes are essential for understanding macroecological and biogeographical patterns as well as ecosystem-level processes. Moving seamlessly across scales and subdisciplines, Metacommunity Ecology is an invaluable reference, one that offers a more integrated approach to ecological patterns and processes.

News headlines are forever reporting diseases that take huge tolls on humans, wildlife, domestic animals, and both cultivated and native plants worldwide. These diseases can also completely transform the ecosystems that feed us and provide us with other critical benefits, from flood control to water purification. And yet diseases sometimes serve to maintain the structure and function of the ecosystems on which humans depend. Gathering thirteen essays by forty leading experts who convened at the Cary Conference at the Institute of Ecosystem Studies in 2005, this book develops an integrated framework for understanding where these diseases come from, what ecological factors influence their impacts, and how they in turn influence ecosystem dynamics. It marks the first comprehensive and in-depth exploration of the rich and complex linkages between ecology and disease, and provides conceptual underpinnings to understand and ameliorate epidemics. It also sheds light on the roles that diseases play in ecosystems, bringing vital new insights to landscape management issues in particular. While the ecological context is a key piece of the puzzle, effective control and understanding of diseases requires the interaction of professionals in medicine, epidemiology, veterinary medicine, forestry, agriculture, and ecology. The essential resource on the subject, Infectious Disease Ecology seeks to bridge these fields with an ecological approach that focuses on systems thinking and complex interactions.

Williams, Damon L. Williford

Population ecologists study how births and deaths affect the dynamics of populations and communities, while ecosystem ecologists study how species control the flux of energy and materials through food webs and ecosystems. Although all these processes occur simultaneously in nature, the mathematical frameworks bridging the two disciplines have developed independently. Consequently, this independent development of theory has impeded the cross-fertilization of population and ecosystem ecology. Using recent developments from dynamical systems theory, this advanced undergraduate/graduate level textbook shows how to bridge the two disciplines seamlessly. The book shows how bifurcations between the solutions of models can help understand regime shifts in natural populations and ecosystems once thresholds in rates of births, deaths, consumption, competition, nutrient inputs, and decay are crossed. Mathematical Ecology is essential reading for students of ecology who have had a first course in calculus and linear algebra or students in mathematics wishing to learn how dynamical systems theory can be applied to ecological problems.

Until recently community ecology—a science devoted to understanding the patterns and processes of species distribution and abundance—focused mainly on specific and often limited scales of a single community. Since the 1970s, for example, metapopulation dynamics—studies of interacting groups of populations connected through movement—concentrated on the processes of population turnover, extinction, and establishment of new populations. Metacommunities takes the hallmarks of metapopulation theory to the next level by considering a group of communities, each of which may contain numerous populations, connected by species interactions within communities and the movement of individuals between communities. In examining communities open to dispersal, the book unites a broad range of ecological theories, presenting some of the first empirical investigations and revealing the value of the metacommunity approach. The collection of empirical, theoretical, and synthetic chapters in Metacommunities seeks to understand how communities work in fragmented landscapes. Encouraging community ecologists to rethink some of the leading theories of population and community dynamics, Metacommunities urges ecologists to expand the spatiotemporal scales of their research.

A comprehensive framework for understanding species coexistence Coexistence is the central concept in community ecology, but an understanding of this concept requires that we study the actual mechanisms of species interactions. Coexistence in Ecology examines the major features of these mechanisms for species that coexist at different positions in complex food webs and derives empirical tests from model predictions. Mark McPeek explores the various challenges species face by systematically building a model food web, beginning with an ecosystem devoid of life and then adding one species at a time. With the introduction of each new species, he evaluates the properties it must possess to invade a community and quantifies the changes in the abundances of other species that result from a successful invasion. McPeek continues this process until he achieves a multi-trophic level food web with many species coexisting at each trophic level, from omnivores, mutualists, and pathogens to herbivores, carnivores, and basic plants. He then describes the observational and experimental empirical studies that can test the theoretical predictions resulting from the model analyses. Synthesizing decades of theoretical research in community ecology, Coexistence in Ecology offers new perspectives on how to develop an empirical program of study rooted in the natural histories of species and the mechanisms by which they actually interact with one another.

Publisher description

Despite often violent fluctuations in nature, species extinction is rare. California red scale, a potentially devastating pest of citrus, has been suppressed for fifty years in California to extremely low yet stable densities by its controlling parasitoid. Some larch budmoth populations undergo extreme cycles; others never cycle. In Consumer-Resource Dynamics, William Murdoch, Cherie Briggs, and Roger Nisbet use these and numerous other biological examples to lay the groundwork for a unifying theory applicable to predator-prey, parasitoid-host, and other consumer-resource interactions. Throughout, the focus is on how the properties of real organisms affect population dynamics. The core of the book synthesizes and extends the authors' own models involving insect parasitoids and their hosts, and explores in depth how consumer species compete for a dynamic resource. The emerging general consumer-resource theory accounts for how consumers respond to differences among individuals in the resource population. From here the authors move to other models of consumer-resource dynamics and population dynamics in general. Consideration of empirical examples, key concepts, and a necessary review of simple models is followed by examination of spatial processes affecting dynamics, and of implications for biological control of pest organisms. The book establishes the coherence and broad applicability of consumer-resource theory and connects it to single-species dynamics. It closes by stressing the theory's value as a hierarchy of models that allows both generality and testability in the field.

Introduction to Population Ecology, 2nd Edition is a comprehensive textbook covering all aspects of population ecology. It uses a wide variety of field and laboratory examples, botanical to zoological, from the tropics to the tundra, to illustrate the fundamental laws of population ecology. Controversies in population ecology are brought fully up to date in this edition, with many brand new and revised examples and data. Each chapter provides an overview of how population theory has developed, followed by descriptions of laboratory and field studies that have been inspired by the theory. Topics explored include single–species population growth and self–limitation, life histories, metapopulations and a wide range of interspecific interactions including competition, mutualism, parasite–host, predator–prey and plant–herbivore. An additional final chapter, new for the second edition, considers multi–trophic and other complex interactions among species. Throughout the book, the mathematics involved is explained with a step–by–step approach, and graphs and other visual aids are used to present a clear illustration of how the models work. Such features make this an accessible introduction to population ecology; essential reading for undergraduate and graduate students taking courses in population ecology, applied ecology, conservation ecology, and conservation biology, including those with little mathematical experience.

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