Biology Of Populations

An increasing variety of biological problems involving resource management, conservation and environmental quality have been dealt with using the principles of population biology (defined to include population dynamics, genetics and certain aspects of community ecology). There appears to be a mixed record of successes and failures and almost no critical synthesis or reviews that have attempted to discuss the reasons and ways in which population biology, with its remarkable theoretical as well as experimental advances, could find more useful application in agriculture, forestry, fishery, medicine and resource and environmental management. This book provides examples of state-of-the-art applications by a distinguished group of researchers in several fields. The diversity of topics richly illustrates the scientific and economic breadth of their discussions as well as epistemological and comparative analyses by the authors and editors. Several principles and common themes are emphasized and both strengths and potential sources of uncertainty in applications are discussed. This volume will hopefully stimulate new interdisciplinary avenues of problem-solving research.

Fascinated by the diversity of living organisms, humans have always been curious about its origin. Darwin was the first to provide the scholary and persuasive thesis for gradual evolution and speciation under natural selection. Although we now have much information on evolution, we still don't understand it in detail. Many questions still remain open due to the complexity and multiplicity of interacting factors. Several approaches mainly arising from population ecology and genetics are presented in this book in order to help understand genetic variation and evolution.

The book provides an introduction to deterministic (and some stochastic) modeling of spatiotemporal phenomena in ecology, epidemiology, and neural systems. A survey of the classical models in the fields with up to date applications is given. The book begins with detailed description of how spatial dynamics/diffusive processes influence the dynamics of biological populations. These processes play a key role in understanding the outbreak and spread of pandemics which help us in designing the control strategies from the public health perspective. A brief discussion on the functional mechanism of the brain (single neuron models and network level) with classical models of neuronal dynamics in space and time is given. Relevant phenomena and existing modeling approaches in ecology, epidemiology and neuroscience are introduced, which provide examples of pattern formation in these models. The analysis of patterns enables us to study the dynamics of macroscopic and microscopic behaviour of underlying systems and travelling wave type patterns observed in dispersive systems. Moving on to virus dynamics, authors present a detailed analysis of different types models of infectious diseases including two models for influenza, five models for Ebola virus and seven models for Zika virus with diffusion and time delay. A Chapter is devoted for the study of Brain Dynamics (Neural systems in space and time). Significant advances made in modeling the reaction-diffusion systems are presented and spatiotemporal patterning in the systems is reviewed. Development of appropriate mathematical models and detailed analysis (such as linear stability, weakly nonlinear analysis, bifurcation analysis, control theory, numerical simulation) are presented. Key Features Covers the fundamental concepts and mathematical skills required to analyse reaction-diffusion models for biological populations. Concepts are introduced in such a way that readers with a basic knowledge of differential equations and numerical methods can understand the analysis. The results are also illustrated with figures. Focuses on mathematical modeling and numerical simulations using basic conceptual and classic models of population dynamics, Virus and Brain dynamics. Covers wide range of models using spatial and non-spatial approaches. Covers single, two and multispecies reaction-diffusion models from ecology and models from bio-chemistry. Models are analysed for stability of equilibrium points, Turing instability, Hopf bifurcation and pattern formations. Uses Mathematica for problem solving and MATLAB for pattern formations. Contains solved Examples and Problems in Exercises. The Book is suitable for advanced undergraduate, graduate and research students. For those who are working in the above areas, it provides information from most of the recent works. The text presents all the fundamental concepts and mathematical skills needed to build models and perform analyses.

Despite decades of developments in immunization and drug therapy, tuberculosis remains among the leading causes of human mortality, and no country has successfully eradicated the disease. Reenvisioning tuberculosis from the perspective of population biology, this book examines why the disease is so persistent and what must be done to fight it. Treating tuberculosis and its human hosts as dynamic, interacting populations, Christopher Dye seeks new answers to key questions by drawing on demography, ecology, epidemiology, evolution, and population genetics. Dye uses simple mathematical models to investigate how cases and deaths could be reduced, and how interventions could lead to TB elimination. Dye's analysis reveals a striking gap between the actual and potential impact of current interventions, especially drug treatment, and he suggests placing more emphasis on early case detection and the treatment of active or incipient tuberculosis. He argues that the response to disappointingly slow rates of disease decline is not to abandon long-established principles of chemotherapy, but to implement them with greater vigor. Summarizing epidemiological insights from population biology, Dye stresses the need to take a more inclusive view of the factors that affect disease, including characteristics of the pathogen, individuals and populations, health care systems, and physical and social environments. In broadening the horizons of TB research, The Population Biology of Tuberculosis demonstrates what must be done to prevent, control, and defeat this global threat in the twenty-first century.

The goal of this book is to search for a balance between simple and analyzable models and unsolvable models which are capable of addressing important questions on population biology. Part I focusses on single species simple models including those which have been used to predict the growth of human and animal population in the past. Single population models are, in some sense, the building blocks of more realistic models -- the subject of Part II. Their role is fundamental to the study of ecological and demographic processes including the role of population structure and spatial heterogeneity -- the subject of Part III. This book, which will include both examples and exercises, is of use to practitioners, graduate students, and scientists working in the field.

This volume unifies population studies emphasising the interplay between modelling and experimentation.

Updated to include two new chapters, a modified Part II structure, more recent empirical examples, and online spreadsheet simulations.

Provides a quantitative and Darwinian perspective on population biology, with problem sets, simulations and worked examples to aid the student.

Introduction to Population BiologyCambridge University Press

Population Biology of Vector-Borne Diseases is the first comprehensive survey of this rapidly developing field. The chapter topics provide an up-to-date presentation of classical concepts, reviews of emerging trends, synthesis of

existing knowledge, and a prospective agenda for future research. The contributions offer authoritative and international perspectives from leading thinkers in the field. The dynamics of vector-borne diseases are far more intrinsically ecological compared with their directly transmitted equivalents. The environmental dependence of ectotherm vectors means that vector-borne pathogens are acutely sensitive to changing environmental conditions. Although perennially important vector-borne diseases such as malaria and dengue have deeply informed our understanding of vector-borne diseases, recent emerging viruses such as West Nile virus, Chikungunya virus, and Zika virus have generated new scientific questions and practical problems. The study of vector-borne disease has been a particularly rich source of ecological questions, while ecological theory has provided the conceptual tools for thinking about their evolution, transmission, and spatial extent. Population Biology of Vector-Borne Diseases is an advanced textbook suitable for graduate level students taking courses in vector biology, population ecology, evolutionary ecology, disease ecology, medical entomology, viral ecology/evolution, and parasitology, as well as providing a key reference for researchers across these fields.
This book, written in 1977, brought together for the first time, the current knowledge of plants that might be relevant to understanding their population

biology. ¿This monumental volume did more than summarize the state of plant biology; ¿it linked the conceptual and theoretical developments in population ecology, mostly derived from the study of animals, with field observations and experimental evidence of population regulation and life history evolution in plants. ¿ ¿The field of population biology was already well established in the 1960s although with a clear zoocentric emphasis, however, it is because of Harper¿s work that the field experienced a veritable explosion, reached maturity and became a mainstream scientific endeavour worldwide. This field is so vast now that it would be pointless, if not impossible, for someone to summarise it. It is precisely because of this that PBP is as relevant now as it was in 1977. John Harper¿s style of highlighting unanswered questions and the limitations of both theory and empirical evidence served and still serves as foundation for research agendas worldwide. Much remains to be done in this field and this alone makes PBP an essential element in the library of every student/researcher of population biology, whether interested in plants or animals.¿ From the ¿Preface to the 2010 Printing¿ written by José Sarukhán, Rodolfo Dirzo and Miguel Franco.
Proposes a fresh approach to population biology and ecology. This book proposes and develops an inertial view of population growth, taking note of acceleration, or rate of change of the growth rate between consecutive

generations. It is useful for population biologists, ecological modellers, and theoretical biologists and philosophers of science.

Dynamics.

This book explores the factors affecting the survival of small populations. As the human impact on Earth expands, populations of many wild species are being squeezed into smaller and smaller habitats. As a consequence, they face an increasing threat of extinction. National and international conservation groups rush to add these populations, species and sub-species to their existing endangered and threatened lists. In nations with strong conservation laws, listing often triggers elaborate plans to rescue declining populations and restore their habitats. The authors review these theoretical ideas, the existing data, and explore the question: how well do small and isolated populations actually perform? Their case study group is the song sparrows of Mandarte Island, British Columbia. This population is small enough and isolated enough so that all individuals can be uniquely marked and their survival and reproduction monitored over many generations. This is one of the strongest long-term ecological studies of a contained vertebrate population, now in its 31st year.

In this new century mankind faces ever more challenging environmental and publichealthproblems,suchaspollution,invasionbyexoticspecies,theem- gence of new diseases or the emergence of diseases into new regions (West Nile virus,SARS,Anthrax,etc.),andtheresurgenceofexistingdiseases(in?uenza, malaria, TB, HIV/AIDS, etc.). Mathematical models have been successfully used to study many biological, epidemiological and medical problems, and nonlinear and complex dynamics have been observed in all of those contexts. Mathematical studies have helped us not only to better understand these problems but also to ?nd solutions in some cases, such as the prediction and control of SARS outbreaks, understanding HIV infection, and the investi- tion of antibiotic-resistant infections in hospitals. Structuredpopulationmodelsdistinguishindividualsfromoneanother- cording to characteristics such as age, size, location, status, and movement, to determine the birth, growth and death rates, interaction with each other and with environment, infectivity, etc. The goal of structured population models is to understand how these characteristics a?ect the dynamics of these models and thus the outcomes and consequences of the biological and epidemiolo- cal processes. There is a very large and growing body of literature on these topics. This book deals with the recent and important advances in the study of structured population models in biology and epidemiology. There are six chapters in this book, written by leading researchers in these areas.

Despite various studies carried out by scientific centres for population biology research in the USSR, many findings remain unknown to Western scientists. This collection of reviews on population biology in the USSR, attempts to remedy the situation. The areas covered include surveys of animal population biology studies - population genetics, population ecology and ecophysiology, population ethology, population cytogenetics, and population radioecology. Also explored are the population biology of amphibians and invertebrates, the population biology of the lower taxa - plants, protists, and microorganisms, and some general problems of population biology.

Hanski, a leading thinker in metapopulation ecology, studies checkerspot butterfly populations in Finland. Ehrlich, one of the leading ecologists and conservation biologist, investigates checkerspot butterfly populations in California. This book reports on and synthsizes the major long-term research of both workers' careers on the population biology of checkerspot butterflies.

The present book describes novel theories of mutation pathogen systems showing critical fluctuations, as a paradigmatic example of an application of the mathematics of critical phenomena to the life sciences. It will enable the reader to understand the implications and future impact of these findings, yet at same time allow him to actively follow the mathematical tools and scientific origins of critical

phenomena. This book also seeks to pave the way to further fruitful applications of the mathematics of critical phenomena in other fields of the life sciences.
A detailed introduction to the genetic and demographic issues relevant to the conservation of fragmented populations.
Concepts of Biology is designed for the single-semester introduction to biology course for non-science majors, which for many students is their only college-level science course. As such, this course represents an important opportunity for students to develop the necessary knowledge, tools, and skills to make informed decisions as they continue with their lives. Rather than being mired down with facts and vocabulary, the typical non-science major student needs information presented in a way that is easy to read and understand. Even more importantly, the content should be meaningful. Students do much better when they understand why biology is relevant to their everyday lives. For these reasons, Concepts of Biology is grounded on an evolutionary basis and includes exciting features that highlight careers in the biological sciences and everyday applications of the concepts at hand.We also strive to show the interconnectedness of topics within this extremely broad discipline. In order to meet the needs of today's instructors and students, we maintain the overall organization and coverage found in most syllabi for this course. A strength of

Concepts of Biology is that instructors can customize the book, adapting it to the approach that works best in their classroom. Concepts of Biology also includes an innovative art program that incorporates critical thinking and clicker questions to help students understand--and apply--key concepts.

Introduction to population biology; The genetic structure of populations; Evolution at the population level; Population size: growth and dynamics; Regulatory systems in populations; Dispersion, dispersal, and populations; Population structure: age and sex; Life history patterns and selection in populations; Mating systens and behavior in populations; Seasonality and populations; Interactions of unrelated populations in communities.

Extraordinary in the diversity of their lifestyles, insect parasitoids have become extremely important study organisms in the field of population biology, and they are the most frequently used agents in the biological control of insect pests. This book presents the ideas of seventeen international specialists, providing the reader not only with an overview but also with lively discussions of the most salient questions pertaining to the field today and prescriptions for avenues of future research. After a general introduction, the book divides into three main sections: population dynamics, population diversity, and population applications. The first section covers gaps in our knowledge in parasitoid behavior, parasitoid persistence, and how space and landscape affect dynamics. The contributions on population diversity consider how evolution has molded parasitoid populations and communities. The final section calls for novel approaches toward resolving the enigma of success in biological control and questions why parasitoids have been largely neglected in conservation biology. Parasitoid Population Biology will likely be an important influence on research well into the twenty-first century and will provoke discussion amongst parasitoid biologists and population biologists. In addition to the editors, the contributors are Carlos Bernstein, Jacques Brodeur, Jerome Casas, H.C.J. Godfray, Susan Harrison, Alan Hastings, Bradford A. Hawkins, George E. Heimpel, Marcel Holyoak, Nick Mills, Bernard D. Roitberg, Jens Roland, Michael R. Strand, Teja Tscharntke, and Minus van Baalen.

This expository book presents the mathematical description of evolutionary models of populations subject to interactions (e.g. competition) within the population. The author includes both models of finite populations, and limiting models as the size of the population tends to infinity. The size of the population is described as a random function of time and of the initial population (the ancestors at time 0). The genealogical tree of such a population is given. Most models imply that the population is bound to go extinct in finite time. It is explained when the interaction is strong enough so that the extinction time remains finite, when the ancestral population at time 0 goes to infinity. The material could be used for teaching stochastic processes, together with their applications. Étienne Pardoux is Professor at Aix-Marseille University, working in the field of Stochastic Analysis, stochastic partial differential equations, and probabilistic models in evolutionary biology and population genetics. He obtained his PhD in 1975 at University of Paris-Sud.

This study elucidates the biological and behavioural processes leading to the successful adaptation of circumpolar human populations.

This book is an outgrowth of one phase of an upper-division course on quantitative ecology, given each year for the past eight at Berkeley. I am most grateful to the students in that course and to many graduate students in the Berkeley Department of Zoology and Colleges of Engineering and Natural Resources whose spirited discussions inspired much of the book's content. I also am deeply grateful to those faculty colleagues with whom, at one time or another, I have shared courses or seminars in ecology or population biology, D.M. Auslander, L. Demetrius, G. Oster, O.H. Paris, F.A. Pitelka, A.M. Schultz, Y. Takahashi, D.B. Tyler, and P. Vogelhut, all of whom contributed substantially to the development of my thinking in those fields, to my Depart mental colleagues E. Polak and A.J. Thomasian, who guided me into the litera ture on numerical methods and stochastic processes, and to the graduate students who at one time or another have worked with me on population-biology projects, L.M. Brodnax, S-P. Chan, A. Elterman, G.C. Ferrell, D. Green, C. Hayashi, K-L. Lee, W.F. Martin Jr., D. May, J. Stamnes, G.E. Swanson, and I. Weeks, who, together, undoubtedly provided me with the greatest inspiration. I am indebted to the copy-editing and production staff of Springer-Verlag, especially to Ms. M. Muzeniek, for their diligence and skill, and to Mrs. Alice Peters, biomathematics editor, for her patience.

Population biology has been investigated quantitatively for many decades, resulting in a rich body of scientific literature. Ecologists often avoid this literature, put off by its apparently formidable mathematics. This textbook provides an introduction to the biology and ecology of populations by emphasizing the roles of simple mathematical models in explaining the growth and behavior of populations. The author only assumes acquaintance with elementary calculus, and provides tutorial explanations where needed to develop mathematical concepts.

Examples, problems, extensive marginal notes and numerous graphs enhance the book's value to students in classes ranging from population biology and population ecology to mathematical biology and mathematical ecology. The book will also be useful as a supplement to introductory courses in ecology.
Population dynamics is an important subject in mathematical biology. A cen tral problem is to study the long-term behavior of modeling systems. Most of these systems are governed by various evolutionary equations such as difference, ordinary, functional, and partial differential equations (see, e. g. , [165, 142, 218, 119, 55]). As we know, interactive populations often live in a fluctuating environment. For example, physical environmental conditions such as temperature and humidity and the availability of food, water, and other resources usually vary in time with seasonal or daily variations. Therefore, more realistic models should be nonautonomous systems. In particular, if the data in a model are periodic functions of time with commensurate period, a periodic system arises; if these periodic functions have different (minimal) periods, we get an almost periodic system. The existing reference books, from the dynamical systems point of view, mainly focus on autonomous biological systems. The book of Hess [106J is an excellent reference for periodic parabolic boundary value problems with applications to population dynamics. Since the publication of this book there have been extensive investigations on periodic, asymptotically periodic, almost periodic, and even general nonautonomous biological systems, which in turn have motivated further development of the theory of dynamical systems. In order to explain the dynamical systems approach to periodic population problems, let us consider, as an illustration, two species periodic competitive systems dUI dt = !I(t,Ul,U2), (0.

When we wrote this book it was, admittedly, flrst of all for the sake of our own enjoyment and enlightenment. We will, however, add our sincerely meant (but rather traditional) hope that it will prove interesting to graduate students, to colleagues and to anyone else, who will bother to read it. The book was written as a joint effort by a theoretically inclined population geneticist and an experimental ecologist who share opinions on what is interesting in the fleld of theoretical ecology. While we believe that qualifled natural history is of indisputable intrinsic value, we think that ecology is a natural science which should have a theoretical framework. On the other hand, theoretical ecology must draw its inspiration from nature and yield results which give insight into the flndings of the naturalist and inspire him to make new observations and experiments. Without this relationship between fleld biology and theory, mathe matical ecology may become a discipline totally divorced from biology and solve-albeit interesting-mathematical problems without signiflcance for ecology. Therefore, in addition to theoretical population biology (including some original models) the book also discusses observational data from nature to show how the theoretical models give new insight and how observations give rise to new theoretical thought. While no book on ecology could do without the mention of the hare-lynx example (and ours is, therefore, no exception) we have tried to bring new examples mainly derived from one of the authors' fleld of experience: microbial ecology and marine biology.

This volume contains the papers presented at a symposium on popula tion biology sponsored by the Deutsche Forschungsgemeinschaft. It was . held at the guest house of the University of Ttibingen at Oberjoch on May 15-19, 1983. Prior to this conference a small group of European biologists had met in Berlin (June 1981) and Pavia (September 1982) to discuss re search problems on the borderline between population genetics and evolutionary ecology. From the contributions and discussions at these meetings it became evident that the unification of approaches to evolutionary problems in population genetics and evolutionary ecology has not yet been suc cessful and requires further efforts. It was the consensus that a larger symposium with international participation would be helpful to con front and discuss the different approaches to population biology in order to assess "where we are now" and "where we should be going. " As a result an organizational committee was formed (F. Christiansen, S. Jayakar, V. Loeschcke, W. Scharloo, and K. W6hrmann) to iden tify topics that seemed, at least to them, to be fruitful in tackling problems in population biology. Consequently, a number of colleagues were asked to participate in the meeting. We have divided this book into chapters corresponding to the eight topics chosen. The volume begins with the relation between genotype and phenotype and is followed by a chapter on quantitative genetics and selection in natural populations.

This 2004 collection of essays deals with the foundation and historical development of population biology and its relationship to population genetics and population ecology on the one hand and to the rapidly growing fields of molecular quantitative genetics, genomics and bioinformatics on the other. Such an interdisciplinary treatment of population biology has never been attempted before. The volume is set in a historical context, but it has an up-to-date coverage of material in various related fields. The areas covered are the foundation of population biology, life history evolution and demography, density and frequency dependent selection, recent advances in quantitative genetics and bioinformatics, evolutionary case history of model organisms focusing on polymorphisms and selection, mating system evolution and evolution in the hybrid zones, and applied population biology including conservation, infectious diseases and human diversity. This is the third of three volumes published in honour of Richard Lewontin.

for the design of control programs; in extreme cases (as dis cussed below, by Fine et al. , this volume, and elsewhere) it can happen that immunization programs, although they protect vaccinated individuals, actually increase the overall incidence of a particular disease. The possibility that many nonhuman animal populations may be regulated by parasitic infections is another topic where it may be argued that conventional disciplinary boundaries have retarded investigation. While much ecological research has been devoted to exploring the extent to which competition or predator-prey interactions may regulate natural populations or set their patterns of geographical distribution, few substan tial studies have considered the possibility that infectious diseases may serve as regulatory agents (1,8). On the other hand, the many careful epidemiological studies of the trans mission and maintenance of parasitic infections in human and other animal populations usually assume the host population density to be set by other considerations, and not dynamically engaged with the disease (see, for example, (1,2)). With all these considerations in mind, the Dahlem Workshop from which this book derives aimed to weave strands together -- testing theoretical analysis against empirical facts and patterns, and identifying outstanding problems -- in pursuit of a better un derstanding of the overall population biology of parasitic in fections. For the purpose of the workshop, the term "parasite" was de fined widely to include viruses, bacteria, protozoans, fungi, and helminths.