

INTERDISCIPLINARY APPLIED MATHEMATICS

MATHEMATICAL BIOLOGY

# Diffusion and Ecological Problems

Modern Perspectives



Akira Okubo  
Simon A. Levin

Second Edition



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# Diffusion And Ecological Problems Modern Perspectives Interdisciplinary Applied Mathematics Volume 14

**Fred Jopp, Hauke Reuter, Broder  
Breckling**



## **Diffusion And Ecological Problems Modern Perspectives Interdisciplinary Applied Mathematics Volume 14:**

Diffusion and Ecological Problems: Modern Perspectives Akira Okubo, Smon A. Levin, 2013-04-17 Surveying a wide variety of mathematical models of diffusion in the ecological context this book is written with the primary intent of providing scientists particularly physicists but also biologists with some background of the mathematics and physics of diffusion and how they can be applied to ecological problems Equally this is a specialized text book for graduates interested in mathematical ecology assuming no more than a basic knowledge of probability and differential equations Each chapter in this new edition has been substantially updated by appropriate leading researchers in the field and contains much new material covering recent developments

**Lie and non-Lie Symmetries: Theory and Applications for Solving Nonlinear Models** Roman M. Cherniha, 2018-07-06 This book is a printed edition of the Special Issue Lie Theory and Its Applications that was published in *Symmetry*

**Nonlinear Reaction-Diffusion-Convection Equations** Roman Cherniha, Mykola Serov, Oleksii Pliukhin, 2017-11-02 It is well known that symmetry based methods are very powerful tools for investigating nonlinear partial differential equations PDEs notably for their reduction to those of lower dimensionality e g to ODEs and constructing exact solutions This book is devoted to 1 search Lie and conditional non classical symmetries of nonlinear RDC equations 2 constructing exact solutions using the symmetries obtained and 3 their applications for solving some biologically and physically motivated problems The book summarises the results derived by the authors during the last 10 years and those obtained by some other authors

**Proceedings "WASCOM 2007", 14th Conference on Waves and Stability in Continuous Media** Roberto Monaco, 2008 This volume is the fifth in a series of proceedings which started in 1999 The contributions include the latest results on the theory of wave propagation extended thermodynamics and the stability of the solutions to partial differential equations

*The Zoological Record*, 2002 *Encyclopedia of Theoretical Ecology* Dr. Alan Hastings, Dr. Louis Gross, 2012-05-31 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

*Mechanistic Home Range Analysis* Paul R. Moorcroft, Mark A. Lewis, 2013-10-31 Spatial patterns of movement are fundamental to the ecology of animal populations influencing their social organization mating systems demography and the spatial distribution of prey and competitors However our ability to understand the causes and consequences of animal home range patterns has been limited

by the descriptive nature of the statistical models used to analyze them In Mechanistic Home Range Analysis Paul Moorcroft and Mark Lewis develop a radically new framework for studying animal home range patterns based on the analysis of correlated random walk models for individual movement behavior They use this framework to develop a series of mechanistic home range models for carnivore populations The authors analysis illustrates how in contrast to traditional statistical home range models that merely describe pattern mechanistic home range models can be used to discover the underlying ecological determinants of home range patterns observed in populations make accurate predictions about how spatial distributions of home ranges will change following environmental or demographic disturbance and analyze the functional significance of the movement strategies of individuals that give rise to observed patterns of space use By providing researchers and graduate students of ecology and wildlife biology with a more illuminating way to analyze animal movement Mechanistic Home Range Analysis will be an indispensable reference for years to come

**Analytic Methods for Coagulation-Fragmentation Models, Volume I** Jacek Banasiak, Wilson Lamb, Philippe Laurencot, 2019-09-04 Analytic Methods for Coagulation Fragmentation Models is a two volume set that provides a comprehensive exposition of the mathematical analysis of coagulation fragmentation models Initially an in depth survey of coagulation fragmentation processes is presented together with an account of relevant early results obtained on the associated model equations These provide motivation for the subsequent detailed treatment of more up to date investigations which have led to significant theoretical developments on topics such as solvability and the long term behaviour of solutions To make the account as self contained as possible the mathematical tools that feature prominently in these modern treatments are introduced at appropriate places The main theme of Volume I is the analysis of linear fragmentation models with Volume II devoted to processes that involve the nonlinear contribution of coagulation Features of Volume I The main models of the theory together with their derivations and early methods of solution A detailed presentation of the operator theoretical methods and semigroup theory that play an essential role in the theory of fragmentation processes A comprehensive theory of fragmentation processes including fragmentation with growth and decay in both the discrete and continuous particle size cases An analytical explanation of the pathologies of the fragmentation equation such as the shattering phase transition and non uniqueness of solutions An analysis of the long term dynamics of the discrete size fragmentation equation with growth

**Stochastic Calculus via Regularizations** Francesco Russo, Pierre Vallois, 2022-11-15 The book constitutes an introduction to stochastic calculus stochastic differential equations and related topics such as Malliavin calculus On the other hand it focuses on the techniques of stochastic integration and calculus via regularization initiated by the authors The definitions relies on a smoothing procedure of the integrator process they generalize the usual Itô and Stratonovich integrals for Brownian motion but the integrator could also not be a semimartingale and the integrand is allowed to be anticipating The resulting calculus requires a simple formalism nevertheless it entails pathwise techniques even though it takes into

account randomness It allows connecting different types of pathwise and non pathwise integrals such as Young fractional Skorohod integrals enlargement of filtration and rough paths The covariation but also high order variations play a fundamental role in the calculus via regularization which can also be applied for irregular integrators A large class of Gaussian processes various generalizations of semimartingales such that Dirichlet and weak Dirichlet processes are revisited Stochastic calculus via regularization has been successfully used in applications for instance in robust finance and on modeling vortex filaments in turbulence The book is addressed to PhD students and researchers in stochastic analysis and applications to various fields

**Modelling Complex Ecological Dynamics** Fred Jopp,Hauke Reuter,Broder Breckling,2011-02-11 Model development is of vital importance for understanding and management of ecological processes Identifying the complex relationships between ecological patterns and processes is a crucial task Ecological modelling both qualitatively and quantitatively plays a vital role in analysing ecological phenomena and for ecological theory This textbook provides a unique overview of modelling approaches Representing the state of the art in modern ecology it shows how to construct and work with various different model types It introduces the background of each approach and its application in ecology Differential equations matrix approaches individual based models and many other relevant modelling techniques are explained and demonstrated with their use The authors provide links to software tools and course materials With chapters written by leading specialists Modelling Complex Ecological Dynamics is an essential contribution to expand the qualification of students teachers and scientists alike

**Handbook of Differential Equations: Stationary Partial Differential Equations** Michel Chipot,2011-08-11 This handbook is the sixth and last volume in the series devoted to stationary partial differential equations The topics covered by this volume include in particular domain perturbations for boundary value problems singular solutions of semilinear elliptic problems positive solutions to elliptic equations on unbounded domains symmetry of solutions stationary compressible Navier Stokes equation Lotka Volterra systems with cross diffusion and fixed point theory for elliptic boundary value problems Collection of self contained state of the art surveys Written by well known experts in the field Informs and updates on all the latest developments

Asymptotic Methods in Nonlinear Wave Phenomena Tommaso Ruggeri,Antonio M. Greco,Marco Sammartino,2007 This book brings together several contributions from leading experts in the field of nonlinear wave propagation This field which during the last three decades has seen important breakthroughs from the theoretical point of view has recently acquired increased relevance due to advances in the technology of fluids e g at microscale or nanoscale and the recognition of crucial applications to the understanding of biological phenomena Nonlinear wave theory requires the use of disparate approaches including formal and rigorous asymptotic methods Lie group theory energy methods numerical analysis and bifurcation theory This book presents a unique blend in which different aspects of the theory are enlightened and several real life applications are investigated The book will be a valuable resource for applied scientists interested in some of the most recent advances in the theory and in the

applications of wave propagation shock formation nonequilibrium thermodynamics and energy methods      Aspects of Mathematical Modelling Roger J. Hosking,Ezio Venturino,2008-03-02 The construction of mathematical models is an essential scientific activity Mathematics is associated with developments in science and engineering but more recently mathematical modelling has been used to investigate complex systems that arise in other fields This book demonstrates the application of mathematics to research topics in ecology and environmental science health and medicine phylogenetics and neural networks theoretical chemistry economics and management      Recent Advances in iPSC Technology Alexander Birbrair,2021-03-31 The series Advances in Stem Cell Biology is a timely and expansive collection of comprehensive information and new discoveries in the field of stem cell biology Recent Advances in iPSC Technology Volume 5 addresses the progress in induced pluripotent stem cells iPSCs technologies Somatic cells can be reprogrammed into iPSCs by the expression of specific transcription factors These cells are transforming biomedical research in the last 15 years The volume teaches readers about current advances in the field This book describes different technologies and strategies to use iPSCs for biological and clinical benefit In recent years remarkable progress has been made in the obtention of iPSCs and their differentiation into several cell types tissues and organs using state of the art techniques These advantages facilitated identification of key targets and definition of the molecular basis of several disorders This volume will cover hot topics in the iPSC field such as iPSCs for modeling the cardiovascular toxicities of anticancer therapies iPSC differentiation through the lens of the noncoding genome modeling of blood brain barrier with iPSCs mathematical modeling of iPSCs iPSCs to study human brain evolution selfrenewal in iPSCs differences and similarities between iPSCs and embryonic stem cells and more The volume is written for researchers and scientists interested in stem cell therapy cell biology regenerative medicine and organ transplantation and is contributed by world renowned authors in the field Provides overview of the fast moving field of induced pluripotent stem cell technology regenerative medicine and therapeutics Covers the following topics iPSCs for modeling the cardiovascular toxicities of anticancer therapies iPSC differentiation through the lens of the non coding genome modeling of blood brain barrier with iPSCs mathematical modelling of iPSCs iPSCs to study human brain evolution self renewal in iPSCs differences and similarities between iPSCs and embryonic stem cells and more Contributed by world renown experts in the field      A Practical Guide to Ecological Modelling Karline Soetaert,Peter M. J. Herman,2008-10-14 Mathematical modelling is an essential tool in present day ecological research Yet for many ecologists it is still problematic to apply modelling in their research In our experience the major problem is at the conceptual level proper understanding of what a model is how ecological relations can be translated consistently into mathematical equations how models are solved steady states calculated and interpreted Many textbooks jump over these conceptual hurdles to dive into detailed formulations or the mathematics of solution This book attempts to fill that gap It introduces essential concepts for mathematical modelling explains the mathematics behind the methods and helps readers to implement models and obtain

hands on experience Throughout the book emphasis is laid on how to translate ecological questions into interpretable models in a practical way The book aims to be an introductory textbook at the undergraduate graduate level but will also be useful to seduce experienced ecologists into the world of modelling The range of ecological models treated is wide from Lotka Volterra type of principle seeking models to environmental or ecosystem models and including matrix models lattice models and sequential decision models All chapters contain a concise introduction into the theory worked out examples and exercises All examples are implemented in the open source package R thus taking away problems of software availability for use of the book All code used in the book is available on a dedicated website

*Handbook of Scaling Methods in Aquatic Ecology* Laurent Seuront, Peter G. Strutton, 2003-09-25 The evolution of observational instruments simulation techniques and computing power has given aquatic scientists a new understanding of biological and physical processes that span temporal and spatial scales This has created a need for a single volume that addresses concepts of scale in a manner that builds bridges between experimentalists and

*Using the Mathematics Literature* Kristine K. Fowler, 2004-05-25 This reference serves as a reader friendly guide to every basic tool and skill required in the mathematical library and helps mathematicians find resources in any format in the mathematics literature It lists a wide range of standard texts journals review articles newsgroups and Internet and database tools for every major subfield in mathematics and details methods of access to primary literature sources of new research applications results and techniques Using the Mathematics Literature is the most comprehensive and up to date resource on mathematics literature in both print and electronic formats presenting time saving strategies for retrieval of the latest information

**The Role of Advection in a Two-Species Competition Model: A Bifurcation Approach** Isabel Averill, King-Yeung Lam, Yuan Lou, 2017-01-18 The effects of weak and strong advection on the dynamics of reaction diffusion models have long been studied In contrast the role of intermediate advection remains poorly understood For example concentration phenomena can occur when advection is strong providing a mechanism for the coexistence of multiple populations in contrast with the situation of weak advection where coexistence may not be possible The transition of the dynamics from weak to strong advection is generally difficult to determine In this work the authors consider a mathematical model of two competing populations in a spatially varying but temporally constant environment where both species have the same population dynamics but different dispersal strategies one species adopts random dispersal while the dispersal strategy for the other species is a combination of random dispersal and advection upward along the resource gradient For any given diffusion rates the authors consider the bifurcation diagram of positive steady states by using the advection rate as the bifurcation parameter This approach enables the authors to capture the change of dynamics from weak advection to strong advection The authors determine three different types of bifurcation diagrams depending on the difference of diffusion rates Some exact multiplicity results about bifurcation points are also presented The authors results can unify some previous work and as a case study about the role of advection also contribute to the understanding of

intermediate relative to diffusion advection in reaction diffusion models      Zoological Record ,2002      **Geometry and Topology in Hamiltonian Dynamics and Statistical Mechanics** Marco Pettini,2007-06-14

It is a special pleasure for me to write this foreword for a remarkable book by a remarkable author. Marco Pettini is a deep thinker who has spent many years probing the foundations of Hamiltonian chaos and statistical mechanics in particular phase transitions from the point of view of geometry and topology. It is in particular the quality of mind of the author and his deep physical as well as mathematical insights which make this book so special and inspiring. It is a must for those who want to venture into a new approach to old problems or want to use new tools for new problems. Although topology has penetrated a number of fields of physics, a broad participation of topology in the clarification and progress of fundamental problems in the above mentioned fields has been lacking. The new perspectives topology gives to the above mentioned problems are bound to help in their clarification and to spread to other fields of science. The sparsity of geometric thinking and of its use to solve fundamental problems when compared with purely analytical methods in physics could be relieved and made highly productive using the material discussed in this book. It is unavoidable that the physicist reader may have then to learn some new mathematics and be challenged to a new way of thinking but with the author as a guide he is assured of the best help in achieving this that is presently available.

## The Enigmatic Realm of **Diffusion And Ecological Problems Modern Perspectives Interdisciplinary Applied Mathematics Volume 14**: Unleashing the Language is Inner Magic

In a fast-paced digital era where connections and knowledge intertwine, the enigmatic realm of language reveals its inherent magic. Its capacity to stir emotions, ignite contemplation, and catalyze profound transformations is nothing short of extraordinary. Within the captivating pages of **Diffusion And Ecological Problems Modern Perspectives Interdisciplinary Applied Mathematics Volume 14** a literary masterpiece penned with a renowned author, readers set about a transformative journey, unlocking the secrets and untapped potential embedded within each word. In this evaluation, we shall explore the book's core themes, assess its distinct writing style, and delve into its lasting impact on the hearts and minds of those that partake in its reading experience.

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### **Introduction**

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