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STABILITY AND
COMPLEXITY IN
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ECOSYSTEMS



WITH A NEW INTRODUCTION BY THE AUTHOR

ROBERT M.
MAY

Stability And Complexity In Model Ecosystems

Daniela Niemeyer



Stability And Complexity In Model Ecosystems:

Stability and Complexity in Model Ecosystems, 2001-03-18 What makes populations stabilize What makes them fluctuate Are populations in complex ecosystems more stable than populations in simple ecosystems In 1973 Robert May addressed these questions in this classic book May investigated the mathematical roots of population dynamics and argued counter to most current biological thinking that complex ecosystems in themselves do not lead to population stability Stability and Complexity in Model Ecosystems played a key role in introducing nonlinear mathematical models and the study of deterministic chaos into ecology a role chronicled in James Gleick s book Chaos In the quarter century since its first publication the book s message has grown in power Nonlinear models are now at the center of ecological thinking and current threats to biodiversity have made questions about the role of ecosystem complexity more crucial than ever In a new introduction the author addresses some of the changes that have swept biology and the biological world since the book s first publication Stability and Complexity in Model Ecosystems Robert M. May,1974 The Description for this book Stability and Complexity in Model Ecosystems MPB 6 will be forthcoming Stability and Complexity in Model Ecosystems R.M. May,1975 **Stability and Complexity in Model Ecosystems**, 2001 *Stability and Complexity in Model Ecosystems* Robert M May,2019-12-31 What makes populations stabilize What makes them fluctuate Are populations in complex ecosystems more stable than populations in simple ecosystems In 1973 Robert May addressed these questions in this classic book May investigated the mathematical roots of population dynamics and argued counter to most current biological thinking that complex ecosystems in themselves do not lead to population stability Stability and Complexity in Model Ecosystems played a key role in introducing nonlinear mathematical models and the study of deterministic chaos into ecology a role chronicled in James Gleick s book Chaos In the quarter century since its first publication the book s message has grown in power Nonlinear models are now at the center of ecological thinking and current threats to biodiversity have made questions about the role of ecosystem complexity more crucial than ever In a new introduction the author addresses some of the changes that have swept biology and the biological world since the book s first publication **Nature's Services** Gretchen Cara Daily,2012-09-26 Life itself as well as the entire human economy depends on goods and services provided by earth s natural systems The processes of cleansing recycling and renewal along with goods such as seafood forage and timber are worth many trillions of dollars annually and nothing could live without them Yet growing human impacts on the environment are profoundly disrupting the functioning of natural systems and imperiling the delivery of these services Nature s Services brings together world renowned scientists from a variety of disciplines to examine the character and value of ecosystem services the damage that has been done to them and the consequent implications for human society Contributors including Paul R Ehrlich Donald Kennedy Pamela A Matson Robert Costanza Gary Paul Nabhan Jane Lubchenco Sandra Postel and Norman Myers present a detailed synthesis of our current understanding of a suite of ecosystem services and a preliminary

assessment of their economic value Chapters consider major services including climate regulation soil fertility pollination and pest control philosophical and economic issues of valuation case studies of specific ecosystems and services implication of recent findings and steps that must be taken to address the most pressing concerns Nature s Services represents one of the first efforts by scientists to provide an overview of the many benefits and services that nature offers to people and the extent to which we are all vitally dependent on those services The book enhances our understanding of the value of the natural systems that surround us and can play an essential role in encouraging greater efforts to protect the earth s basic life support systems before it is too late *Resilience, Stability, and Complexity in Real and Model Ecosystems* Carl Biehl,1976

Theoretical Systems Ecology Efraim Halfon,2012-12-02 Theoretical Systems Ecology Advances and Case Studies aims to relate systems ecology theory to theoretical systems ecologists and other theoreticians in systems science The main language of systems theory is mathematics This book somewhat simplifies concepts advances and developments of the field to non mathematicians who lack background in some aspects of systems ecology It presents examples after every chapter that shows the application of theory to the development and analysis of models This book generally focuses on three problems The first problem is the selection of components found in the system model The definition of the relationships and interactions between the system variables is another concern of this book It also looks into the model analysis These problems are thoroughly discussed in each section of the book The theory of modeling formalisms classes and properties of models are covered in the first two sections of this book A whole section in this book is dedicated to Systems Identification and deals mostly with the problem of extracting information from data Other sections cover model analysis with focus on trends in some aspects such as stability and control theory **The American Naturalist** ,2003 Journal of Mathematical Biology ,1990 *From Populations to Ecosystems* Michel Loreau,2010-07-01 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

The Stability of Model Ecosystems Sunny Elspeth Townsend, 2009 Ecologists would like to understand how complexity persists in nature In this thesis I have taken two fundamentally different routes to study ecosystem stability of model ecosystems classical community ecology and classical population ecology In community ecology models we can study the mathematical mechanisms of stability in general large model ecosystems In population ecology models fewer species are studied but greater detail of species interactions can be incorporated Within these alternative contexts this thesis contributes to two consuming issues concerning the stability of ecological systems the ecosystem stability complexity debate and the causes of cyclic population dynamics One of the major unresolved issues in community ecology is the relationship between ecosystem stability and complexity In 1958 Charles Elton made the conjecture that the stability of an ecological system was coupled to its complexity and this could be a wise principle of coexistence between man and nature with which ecologists could argue the case for the conservation of nature for all species including man The earliest and simplest model systems were randomly constructed and exhibited a negative association between stability and complexity This finding sparked the stability complexity debate and initiated the search for organising principles that enhanced stability in real ecosystems One of the universal laws of ecology is that ecosystems contain many rare and few common species In this thesis I present analytical arguments and numerical results to show that the stability of an ecosystem can increase with complexity when the abundance distribution is characterized by a skew towards many rare species This work adds to the growing number of conditions under which the negative stability complexity relationship can be inverted in theoretical studies While there is growing evidence that the stability complexity debate is progressing towards a resolution community ecology has become increasingly subject to major criticism A long standing criticism is the reliance on local stability analysis There is growing recognition that a global property called permanence is a more satisfactory definition of ecosystem stability because it tests only whether species can coexist Here I identify and explain a positive correlation between the probability of local stability and permanence which suggests local stability is a better measure of species coexistence than previously thought While this offers some relief remaining issues cause the stability complexity debate to evade clear resolution and leave community ecology in a poor position to argue for the conservation of natural diversity for the benefit of all species In classical population ecology a major unresolved issue is the cause of non equilibrium population dynamics In this thesis I use models to study the drivers of cyclic dynamics in Scottish populations of mountain hares *Lepus timidus* for the first time in this system Field studies currently favour the hypothesis that parasitism by a nematode *Trichostrongylus retortaeformis* drives the hare cycles and theory predicts that the interaction should induce cycling Initially I used a simple strategic host parasite model parameterised using available empirical data to test the superficial concordance between theory and observation I find that parasitism could not account for hare cycles This verdict

leaves three options either the parameterisation was inadequate there were missing important biological details or simply that parasites do not drive host cycles Regarding the first option reliable information for some hare parasite model parameters was lacking Using a rejection sampling approach motivated by Bayesian methods I identify the most likely parameter set to predict observed dynamics The results imply that the current formulation of the hare parasite model can only generate realistic dynamics when parasite effects are significantly larger than current empirical estimates and I conclude it is likely that the model contains an inadequate level of detail The simple strategic model was mathematically elegant and allowed mathematical concepts to be employed in analysis but the model was biologically naive The second model is the antipode of the first an individual based model IBM steeped in biological reality that can only be studied by simulation Whilst most highly detailed tactical models are developed as a predictive tool I instead structurally perturb the IBM to study the ecological processes that may drive population cycles in mountain hares The model allows delayed responses to life history by linking maternal body size and parasite infection to the future survival and fecundity of offspring By systematically removing model structure I show that these delayed life history effects are weakly destabilising and allow parameters to lie closer to empirical estimates to generate observed hare population cycles In a third model I structurally modify the simple strategic host parasite model to make it spatially explicit by including diffusion of mountain hares and corresponding advection of parasites transportation with host From initial simulations I show that the spatially extended host parasite equations are able to generate periodic travelling waves PTWs of hare and parasite abundance This is a newly documented behaviour in these widely used host parasite equations While PTWs are a new potential scenario under which cyclic hare dynamics could be explained further mathematical development is required to determine whether adding space can generate realistic dynamics with parameters that lie closer to empirical estimates In the general thesis discussion I deliberate on whether a hare parasite model has been identified which can be considered the right balance between abstraction and relevant detail for this system

An Adaptive Model for the Origin of Invertebrate Skeletons Linda Anne Bodine Fox,1977

Physical Review ,1997-04 Publishes papers that report results of research in statistical physics plasmas fluids and related interdisciplinary topics There are sections on 1 methods of statistical physics 2 classical fluids 3 liquid crystals 4 diffusion limited aggregation and dendritic growth 5 biological physics 6 plasma physics 7 physics of beams 8 classical physics including nonlinear media and 9 computational physics

Knowledge for Sustainable Development Unesco,2002 This three volume set presents a multidisciplinary examination of the global life support systems on which we depend by providing a selection of articles on sustainable development issues written by international experts Volume 1 focuses on the earth and atmospheric sciences mathematical biological and medical sciences social sciences and humanities physical sciences engineering and technology resources Volume 2 covers chemical sciences energy science and water engineering as well as the main issues related to environmental sciences and ecological resources Volume 3 offers a

comprehensive view of food and agricultural engineering resources the management of human and natural resources economic and institutional resources information technology and systems management as well as a regional overview of sustainable development issues Each article includes a bibliography a glossary and a guide to further information available as part of the on line Encyclopedia version <http://www.eolss.net>

Paleobiology, 1982

Complex Ecology Bernard C. Patten, Sven Erik Jørgensen, 1995 For systems ecologists modelers environmental engineers and theoretical ecologists who are interested in mathematics applied to ecology An advanced and up to date treatment of ecological complexity emphasizing the need for holistic systems approaches The book provides a compendium of technically oriented systems approaches to complexity at all levels of ecological organization presenting microscopic and macroscopic views descriptions of modeling approaches feedback and stability and network approaches to trophic dynamics and optimality issues

Ecological Concepts British Ecological Society. Symposium, 1989 This book contains the proceedings of the symposium organized to celebrate the 75th anniversary of the founding of the British Ecological Society and its purpose is to try and assess the contribution which ecology has made to our understanding of the natural world

Asian Perspective, 2006 Journal of international development

Beyond Equilibria Hamish G. Spencer, Sesquicentennial Distinguished Professor Hamish G. Spencer, 2025-03-20 Aimed at a broad audience of graduate students and researchers in ecology and evolution this novel creates a persuasive argument that an explicit consideration of history will often lead to a deeper more nuanced understanding of almost every eco evolutionary system

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