New Models For Ecosystem Dynamics And Restoration The Science And Practice Of Ecological Restoration Series

The proliferation of harmful phytoplankton in marine ecosystems can cause massive fish kills, contaminate seafood with toxins, impact local and regional economies and dramatically affect ecological balance. Real-time observations are essential for effective short-term operational

forecasting, but observation and modelling systems are still being developed. This volume provides guidance for developing real-time and near real-time sensing systems for observing and predicting plankton dynamics, including harmful algal blooms, in coastal waters. The underlying theory is explained and current trends in research and monitoring are discussed.Topics covered include: coastal ecosystems and dynamics of harmful algal blooms; theory and practical applications of in situ and remotely sensed optical detection of microalgal distributions and composition; theory and practical applications of in situ biological and chemical sensors for targeted

species and toxin detection; integrated observing systems and platforms for detection; diagnostic and predictive modelling of ecosystems and harmful algal blooms, including data assimilation techniques; observational needs for the public and government; and future directions for research and operations.

New forms of disturbance, and alteration of current disturbance regimes in arid and semiarid ecosystems, have resulted in the modification and degradation of large regions. This research explores vegetation response as a consequence of two different disturbance events in the southwestern US and northwestern

Mexico. This topic was explored in this dissertation utilizing remotely sensed geospatial information in three separate studies. The first study explores the development of methods to assess the effectiveness of pre-fire restoration efforts, by evaluating vegetation response as a function of local environmental variables. Here I evaluated three fire locations at Bandelier National Monument (New Mexico). My models explain post-fire vegetation response as a function of environmental inputs and pre-fire site conditions (restored, unrestored and control areas). However, further analysis will be needed to better understand the effect of pre-fire restoration

techniques on post-fire vegetation response. My second study explores the development of monitoring practices using remotely sensed data to assess land cover dynamics through time. The study area was the arid agro-ecosystem of La Costa de Hermosillo (LCH) in northwestern Mexico. My results show a continuous tendency towards a decrease in agriculture from 1988 until 2009. Detailed change detection demonstrates high rates of change from agriculture to other land cover classes in areas with dense agricultural developments. Implementation of these monitoring protocols would help with the application of restoration practices.

The third study we used remote sensing time series data to assess phenological trends and variability among land cover types in relation to climatic variability within communities present in a heavily impacted agro-ecosystem (LCH). My analysis comprised three different agricultural land cover types including abandoned agricultural fields, and four additional natural land cover classes. I found that productivity has not increased in abandoned fields (since abandonment). Furthermore, I found that the models developed in this study significantly explain phenological variability as a function of climatic variability. These studies suggest

that the use of remote sensing tools could effectively contribute to our ability to monitor vegetation dynamics in arid ecosystems. The implementation of methodologies generated in this work would significantly inform managers in decision making processes.
Given the importance of interdisciplinary work in sustainability, Simulation of Ecological and Environmental Models introduces the theory and practice of modeling and simulation as applied in a variety of disciplines that deal with earth systems, the environment, ecology, and human-nature interactions. Based on the author's many years of teaching g GLOBEC (GLOBal ocean

ECosystems dynamics) is a research initiative organized by the oceanographic and fisheries communities as a component of the U.S. Global Change Research Program to address the question of how changes in global environment are expected to affect abundances, variations in abundance, and production of animals in the sea. Our approach to this problem is to develop a fundamental understanding of the mechanisms that determine both the abundances of key marine animal populations and their variances in space and time. We assume that the physical environment is a major contributor to patterns of abundance and production of

marine animals, in large part because the planktonic life stages typical of most marine animals are intrinsically at the mercy of fluid motions of the medium in which they live. Consequently, we reason that a logical approach to predicting the potential impact of a globally changing environment is to understand how the physical environment, both directly and indirectly, contributes to animal abundance and its variability in marine ecosystems. GLOBEC's approach to this problem has several definable characteristics: [1] A partnership between physical and biological oceanographers will be needed to assess how population and ecosystem dynamics are linked

to physical phenomena in the sea, from the large scale, such as changing inputs of freshwater modifying buoyancy-driven flows in the entire Gulf of Alaska, for example, to the smaller scales of turbulence, mixing, and transport near-shore and in fronts. [2] GLOBEC's population and ecosystem dynamics approach will require evaluation and integration of the fundamental biological rates of feeding, survivorship, and reproduction. These, in turn, will depend upon passive and active movements of individuals, effects of predators, competitors, and commensals, key aspects of the physical environment, food quality and quantity, and how physics

modify biological interactions. [3] GLOBEC's intent is to construct general physical/biological models of ecosystems dynamics based upon "first-principle" mechanisms of processes that affect the individual organisms. By understanding mechanism we may extrapolate, generalize, and predict from site-specific results. [4] Study sites for GLOBEC field programs are proposed for (1) the Northwest Atlantic, including Georges Bank, as a contribution to the international Cod and Climate Change Program, (2) the California Current ecosystem, as representative of an Eastern Boundary Current upwelling system, (3) the Antarctic, to investigate a high-latitude

system, where models of climate predict some of the greatest climate changes, (4) an open ocean site in the Indian Ocean, where effects of climate-driven variation in monsoon events can be assessed, and possibly (5) an Alaska Current system, where changes in buoyancy-driven coastal flows could be evaluated. [5] The mechanistic understanding of the processes that determine abundance, fluctuation in abundance, and production of marine animals must necessarily involve coupled physical-biological models, linking performance of the individual organism to local and mesoscale physical processes and linking both the biology and local

and regional physics to basin-scale changes in global climate. Modeling will play a substantial role in GLOBEC. [6] An optimistic prognosis for the success of GLOBEC is based in large measure on the potential for novelty and fundamental scientific breakthroughs that can come from integrating the physical and biological processes. The development of new technologies that will allow coverage of biological sampling to approach that now possible in ocean physics promises giant steps forward in appreciating the role of changing physics and global climate in modifying marine ecosystems dynamics.

A Quantitative Approach to the

Development of Ecological Sites and State-and-Transition Models

Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity

With Special Emphasis on Fish Biomass Dynamics

Las Cruces, NM, May 23-25, 1995

Simulation of Ecological and Environmental Models

A compilation of parameters for ecosystem dynamics models of the Scotia Sea - Antarctic Peninsula region

This proceedings contains 50 papers including an overview of shrubland ecosystem dynamics in a changing environment and several papers each on vegetation dynamics,

management concerns and options, and plant ecophysiology as well as an account of a Jornada Basin field trip. Contributions emphasize the impact of changing environmental conditions on vegetative composition especially in the Jornada Basin and Chihuahuan Desert but also in other parts of western North America and the world.

The central concept guiding the management of parks and wilderness over the past century has been “naturalness”—to a large extent the explicit purpose in establishing these special areas was to keep them in their

"natural" state. But what does that mean, particularly as the effects of stressors such as habitat fragmentation, altered disturbance regimes, pollution, invasive species, and climate change become both more pronounced and more pervasive? Beyond Naturalness brings together leading scientists and policymakers to explore the concept of naturalness, its varied meanings, and the extent to which it provides adequate guidance regarding where, when, and how managers should intervene in ecosystem processes to protect park and wilderness values. The main conclusion is the idea that

naturalness will continue to provide an important touchstone for protected area conservation, but that more specific goals and objectives are needed to guide stewardship. The issues considered in Beyond Naturalness are central not just to conservation of parks, but to many areas of ecological thinking—including the fields of conservation biology and ecological restoration—and represent the cutting edge of discussions of both values and practice in the twenty-first century. This bookoffers excellent writing and focus, along with remarkable clarity of thought on

some of the difficult questions being raised in light of new and changing stressors such as global environmental climate change.
It is estimated that roughly 1000 new ecological and environmental models join the ranks of the scientific literature each year. The international peer-reviewed literature reports some 20,000 new models spanning the period from 1970-2010. Just to keep abreast of the field it is necessary to design a handbook of models that doesn't merely list them,
The interaction of land-use and climate can cause non-linear ∅–state∅+ changes in ecosystems, characterized by

persistent differences in structure and function. Changes in land-use and climate on the Colorado Plateau may be driving many ecosystems toward undesired states where energy-intensive measures are required to return to previous states. Landscape classification systems based on 0–ecological potential0+ offer a robust framework to evaluate ecological conditions. Ecological sites are a popular landscape classification system based on long-term ecological potential and are widely used throughout the western US. Ecological sites have been described extensively for rangelands and woodlands on

DOI Bureau of Land Management lands; however, they have yet to be described on USDA Forest Service (USFS) lands. In this thesis, I describe a statistical approach to ecological site delineation and the development of state-and-transition models, diagrams that illustrate ecosystem dynamics and responses to disturbances. In Chapter 2, I used a large inventory dataset and multivariate statistical procedures to classify plots based on life zone, soils, and potential vegetation, effectively delineating statistical ecological site-like groups. Most of the statistical ecological sites matched

ecological sites already described by the USDA Natural Resources Conservation Service (NRCS). Additionally, I described one new ecological site that has not been described by the NRCS in the Colorado Plateau region. In Chapter 3, I examined empirical evidence for alternative states in mountain ponderosa pine (Pinus ponderosa Lawson & C. Lawson) and upland pi©łon-juniper ecosystems. Using multivariate statistical procedures, I found that plots cluster into groups consistent with generalized alternative states identified in a priori conceptual models. Additionally, I showed that

ponderosa pine clusters were true alternative states and pi©łon-juniper clusters were not true alternative states because they were confounded by similarities in climate. Ponderosa pine clusters were differentiated by overstory ponderosa pine density and corresponded to three states: current potential, high fuel load, and reduced overstory. These results illustrate the range of ecosystem variability that is present throughout the study area and present evidence for alternatives states caused by historical land-use. This project is the first to propose ecological sites and state-and-transition

models on USFS lands in this region. These techniques could be applied to areas that do not have formally described ecological sites and state-and-transition models and could help identify ecological sites that may have been overlooked using other means of delineation. Additionally, these methods can be used to evaluate the range of ecological variability throughout an area of interest and to improved understanding of ecosystem dynamics.

From the Past to the Future

Earth Science and Applications from Space

Marine Ecosystem Dynamics

Models: Construction, Application and Development

A Preliminary Comparison of Models for Whole Ecosystem Dynamics

Understanding Complex Ecosystem Dynamics

A Systems and Engineering Perspective

Although the spatial dimension of ecosystem dynamics is now widely recognized, the specific mechanisms behind species patterning in space are still poorly understood and the corresponding theoretical framework is underdeveloped. Going beyond the classical Turing scenario of pattern formation, Spatiotemporal Patterns in Ecology

and Epidemiology:
Both fire and climatic variability have monumental impacts on the dynamics of temperate ecosystems. These impacts can sometimes be extreme or devastating as seen in recent El Nino/La Nina cycles and in uncontrolled fire occurrences. This volume brings together research conducted in western North and South America, areas of a great deal of collaborative work on the influence of people and climate change on fire regimes. In order to give perspective to patterns of change over time, it emphasizes the integration of paleoecological studies with studies of modern ecosystems. Data from a range of

spatial scales, from individual plants to communities and ecosystems to landscape and regional levels, are included. Contributions come from fire ecology, paleoecology, biogeography, paleoclimatology, landscape and ecosystem ecology, ecological modeling, forest management, plant community ecology and plant morphology. The book gives a synthetic overview of methods, data and simulation models for evaluating fire regime processes in forests, shrublands and woodlands and assembles case studies of fire, climate and land use histories. The unique approach of this book gives researchers the benefits of a north-south comparison

as well as the integration of paleoecological histories, current ecosystem dynamics and modeling of future changes.

Most large herbivores require some type of management within their habitats. Some populations of large herbivores are at the brink of extinction, some are under discussion for reintroduction, whilst others already occur in dense populations causing conflicts with other land use. Large herbivores are the major drivers for forming the shape and function of terrestrial ecosystems. This 2006 book addresses the scientifically based action plans to manage both the large herbivore populations and their

habitats worldwide. It covers the processes by which large herbivores not only affect their environment (e.g. grazing) but are affected by it (e.g. nutrient cycling) and the management strategies required. Also discussed are new modeling techniques, which help assess integration processes in a landscape context, as well as assessing the consequences of new developments in the processes of conservation. This book will be essential reading for all involved in the management of both large herbivores and natural resources.

This book presents current meta-ecosystem models and their derivation from classical ecosystem

and metapopulation theories. Specifically, it reviews recent modelling efforts that have emphasized the role of nonlinear dynamics on spatial and food web networks, and which have cast their implications within the context of spatial synchrony and ecological stoichiometry. It suggests that these recent advances naturally lead to a generalization of meta-ecosystem theories to spatial fluxes of matter that have both a trophic and non-trophic impact on species.

Ecosystem dynamics refers to the cycling of matter and energy across ecological compartments through processes such as consumption and recycling. Spatial dynamics

established its ecological roots with metapopulation theories and focuses on scaling up local ecological processes through the limited movement of individuals and matter. Over the last 15 years, theories integrating ecosystem and spatial dynamics have quickly coalesced into meta-ecosystem theories, the focus of this book. The book will be of interest to graduate students and researchers who wish to learn more about the synthesis of ecosystem and spatial dynamics, which form the foundation of the theory of meta-ecosystems.

Northern Forest Ecosystem Dynamics Using Coupled Models and Remote Sensing

Meta-Ecosystem Dynamics
Ecological Stoichiometry
Forest Ecosystem Dynamics
Ecosystem Dynamics of the Boreal Forest
Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms

Predicting how terrestrial ecosystems might respond in the future to large-scale human-generated changes is a major challenge for ecologists. In Terrestrial Ecosystems in Changing Environments, Herman H.

Shugart describes the fundamental ecological concepts, theoretical developments, and quantitative analyses involved in understanding the responses of natural systems to change. The key ecological concepts described include the ecosystem paradigm, niche theory, vegetation/climate relationships, landscape ecology and ecological modeling. A variety of ecological models are presented, and their

applications in predicting responses to change are considered. The challenge of producing ecological models capable of predicting long-term and large-area ecosystem dynamics is reviewed and several examples are provided. Finally, some of the exciting new findings regarding terrestrial landscapes and their feedback with their climatic setting are discussed in the context of human land use and global change.

This report reviews the methods available for examining ecosystem dynamics and assessing the impact of interactions between ecosystems and human activities, particularly fisheries, and their implications for marine fisheries management. It focuses on the currently available models representative of general types such as bionergetic models, predator-prey models and minimally realistic models; with short

descriptions given of model parameters, assumptions and data requirements. It discusses the advantages, disadvantages and limitations of each of the approaches; and concludes with some recommendations for the future development of multi-species and ecosystem models. Many biologists and ecologists have developed models that find widespread use in theoretical

investigations and in applications to organism behavior, disease control, population and metapopulation theory, ecosystem dynamics, and environmental management. This book captures and extends the process of model development by concentrating on the dynamic aspects of these processes and by providing the tools such that virtually anyone with basic knowledge in the Life Sciences can develop meaningful

dynamic models. Examples of the systems modeled in the book range from models of cell development, the beating heart, the growth and spread of insects, spatial competition and extinction, to the spread and control of epidemics, including the conditions for the development of chaos. Key features: - easy-to-learn and easy-to-use software - examples from many subdisciplines of biology, covering models of cells, organisms,

populations, and metapopulations - no prior computer or programming experience required Key benefits: - learn how to develop modeling skills and system thinking on your own rather than use models developed by others - be able to easily run models under alternative assumptions and investigate the implications of these assumptions for the dynamics of the biological system being modeled - develop skills

to assess the dynamics of biological systems In recent decades, the biosphere has become increasingly stressed, often beyond the point where the internal structure and function of ecosystems are sustained. We have experienced an intensified "exploration" of natural system resources to support agricultural and forest production, to provide water for human consumption, to supply the needs of industrial

processes, and to provide, in addition, attractive, diverse landscapes for recreation and tourism. Exceeding thresholds via anthropogenic disturbance that results in degradation of ecosystems is dangerous, since the system-level effects and feedbacks (e.g., soil erosion, famine, polluted drinking water, etc.) are highly undesirable. Finding appropriate compromises in resource use that satisfy

existing competitive interests and result in sound environmental management, especially in densely populated regions, requires an improved understanding of the trade-offs that accompany changes in “exploitation” or altered resource allocation at regional and landscape scales. Progress on landscape-level understanding of coupled water, carbon, and nitrogen budgets is limited by a lack of commitment to a rigorous

development and application of synthetic techniques (e.g., strongly linked remote sensing studies, geographic information system applications, computer simulation modeling, and ecosystem experimentation) more than by basic site-level measurement alone. Possible research approaches that will contribute to new use of ecosystem knowledge in a landscape and regional context were considered by this Dahlem Workshop.

The importance of conducting improved landscape and regional assessment of ecosystem function as input to global scale efforts of the International Geosphere-Biosphere Programme is a major theme of this book.

Ecosystem Collapse and Recovery

A Systematic Approach to Modelling in a Model-rich Environment

Serengeti III

Examining Trends in Post-Disturbance Ecosystem Dynamics in the

Southwestern United States and Northwestern Mexico Using Remote Sensing Time-Series Data and Land Cover Change Detection
Fire and Climatic Change in Temperate Ecosystems of the Western Americas
Ecological Modeling in Risk Assessment
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."

Examines how ecosystems can collapse as a result of human activity, and the ecological processes underlying their subsequent recovery.

Ecosystem Dynamics focuses on long-term terrestrial ecosystems and their changing relationships with human societies. The unique aspect of this text is the long-time scale under consideration as data and insights from the last 10,000 years are used to place present-day ecosystem status into a temporal perspective and to test models that generate forecasts of

future conditions. Descriptions and assessments of some of the current modelling tools that are used, along with their uncertainties and assumptions, are an important feature of this book. An overarching theme explores the dynamic interactions between human societies and ecosystem functioning and services. This book is authoritative but accessible and provides a useful background for all students, practitioners, and researchers interested in the subject. 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.

Human Impacts on Ecosystem Dynamics

Models for an Ecosystem Approach to Fisheries

Beyond Naturalness

General Technical Report RMRS

Rethinking Park and Wilderness Stewardship in an Era of Rapid Change

Modeling Forested Ecosystem Dynamics in the Upper Great Lakes

As scientific understanding about ecological processes has grown, the idea that ecosystem dynamics are complex, nonlinear,

and often unpredictable has gained prominence. Of particular importance is the idea that rather than following an inevitable progression toward an ultimate endpoint, some ecosystems may occur in a number of states depending on past and present ecological conditions. The emerging idea of "restoration thresholds" also enables scientists to recognize when ecological systems are likely to recover on their own and when active restoration efforts are needed. Conceptual models based on alternative stable states and restoration thresholds can help inform restoration efforts.

New Models for Ecosystem Dynamics and Restoration brings together leading experts from around the world to explore how conceptual models of ecosystem dynamics can be applied to the recovery of degraded systems and how recent advances in our understanding of ecosystem and landscape dynamics can be translated into conceptual and practical frameworks for restoration. In the first part of the book, background chapters present and discuss the basic concepts and models and explore the implications of new scientific research on restoration practice. The second part

considers the dynamics and restoration of different ecosystems, ranging from arid lands to grasslands, woodlands, and savannahs, to forests and wetlands, to production landscapes. A summary chapter by the editors discusses the implications of theory and practice of the ideas described in preceding chapters. New Models for Ecosystem Dynamics and Restoration aims to widen the scope and increase the application of threshold models by critiquing their application in a wide range of ecosystem types. It will also help scientists and restorationists correctly diagnose

ecosystem damage, identify restoration thresholds, and develop corrective methodologies that can overcome such thresholds. Understanding Complex Ecosystem Dynamics: A Systems and Engineering Perspective takes a fresh, interdisciplinary perspective on complex system dynamics, beginning with a discussion of relevant systems and engineering skills and practices, including an explanation of the systems approach and its major elements. From this perspective, the author formulates an ecosystem dynamics functionality-based

framework to guide ecological investigations. Next, because complex system theory (across many subject matter areas) is crucial to the work of this book, relevant network theory, nonlinear dynamics theory, cellular automata theory, and roughness (fractal) theory is covered in some detail. This material serves as an important resource as the book proceeds. In the context of all of the foregoing discussion and investigation, a view of the characteristics of ecological network dynamics is constructed. This view, in turn, is the basis for the central hypothesis of the

book, i.e., ecological networks are ever-changing networks with propagation dynamics that are punctuated, local-to-global, and perhaps most importantly fractal. To analyze and fully test this hypothesis, an innovative ecological network dynamics model is defined, designed, and developed. The modeling approach, which seeks to emulate features of real-world ecological networks, does not make a priori assumptions about ecological network dynamics, but rather lets the dynamics develop as the model simulation runs. Model analysis results corroborate the central

hypothesis. Additional important insights and principles are suggested by the model analysis results and by the other supporting investigations of this book – and can serve as a basis for going-forward complex system dynamics research, not only for ecological systems but for complex systems in general. Provides a fresh interdisciplinary perspective, offers a broad integrated development, and contains many new ideas Clearly explains the elements of the systems approach and applies them throughout the book Takes on the challenging and open issues of complex system

network dynamics Develops and utilizes a new, innovative ecosystem dynamics modeling approach Contains over 135 graphic illustrations to help the reader visualize and understand important concepts

Serengeti National Park is one of the world's most diverse ecosystems, a natural laboratory for ecology, evolution, and conservation, with a history that dates back at least four million years to the beginnings of human evolution. The third book of a ground- breaking series, Serengeti III is the result of a long-term integrated research project that documents changes to this

unique ecosystem every ten years. Bringing together researchers from a wide range of disciplines—ecologists, paleontologists, economists, social scientists, mathematicians, and disease specialists— this volume focuses on the interactions between the natural system and the human-dominated agricultural system. By examining how changes in rainfall, wildebeest numbers, commodity prices, and human populations have impacted the Serengeti ecosystem, the authors conclude that changes in the natural system have affected human welfare just as changes in

the human system have impacted the natural world. To promote both the conservation of biota and the sustainability of human welfare, the authors recommend community-based conservation and protected-area conservation. Serengeti III presents a timely and provocative look at the conservation status of one of earth's most renowned ecosystems.

Natural and human-induced changes in Earth's interior, land surface, biosphere, atmosphere, and oceans affect all aspects of life. Understanding these changes requires a range of observations acquired from land-,

sea-, air-, and space-based platforms. To assist NASA, NOAA, and USGS in developing these tools, the NRC was asked to carry out a "decadal strategy" survey of Earth science and applications from space that would develop the key scientific questions on which to focus Earth and environmental observations in the period 2005-2015 and beyond, and present a prioritized list of space programs, missions, and supporting activities to address these questions. This report presents a vision for the Earth science program; an analysis of the existing Earth Observing System and

recommendations to help restore its capabilities; an assessment of and recommendations for new observations and missions for the next decade; an examination of and recommendations for effective application of those observations; and an analysis of how best to sustain that observation and applications system.

The Biology of Elements from Molecules to the Biosphere

The Kluane Project

Theory, Models, and Simulation

Proceedings, Shrubland Ecosystem Dynamics in a Changing Environment

Ecosystem Dynamics of the

Boreal Forest : The Kluane Project

Complexity in Landscape Ecology

The boreal forest is one of the world's great ecosystems, stretching across North America and Eurasia in an unbroken band and containing about 25% of the world's closed canopy forests. The Kluane Boreal Forest Ecosystem Project was a 10-year study by nine of Canada's leading ecologists to unravel the impact of the snowshoe hare cycle on the plants and the other vertebrate species in the boreal forest. In much of the boreal forest, the snowshoe hare acts as a keystone

herbivore, fluctuating in 9-10 year cycles, and dragging along secondary cycles in predators such as lynx and great-horned owls. By manipulating the ecosystem on a large scale from the bottom via fertilizer additions and from the top by predator exclosures, they have traced the plant-herbivore relationships and the predator-prey relationships in this ecosystem to try to answer the question of what drives small mammal population cycles. This study is unique in being large scale and experimental on a relatively simple ecosystem, with the overall goal of defining what determines community structure

in the boreal forest. Ecosystem Dynamics of the Boreal Forest: The Kluane Project summarizes these findings, weaving new discoveries of the role of herbivores-turned-predators, compensatory plant growth, and predators-eating-predators with an ecological story rich in details and clear in its findings of a community where predation plays a key role in determining the fate of individuals and populations. The study of the Kluane boreal forest raises key questions about the scale of conservation required for boreal forest communities and the many mammals and birds that live there.

Interactions matter. To understand the distributions of plants and animals in a landscape you need to understand how they interact with each other, and with their environment. The resulting networks of interactions make ecosystems highly complex. Recent research on complexity and artificial life provides many new insights about patterns and processes in landscapes and ecosystems. This book provides the first overview of that work for general readers. It covers such topics as connectivity, criticality, feedback, and networks, as well as their impact on the stability and predictability of ecosystem

dynamics. With over 60 years of research experience of both ecology and complexity, the authors are uniquely qualified to provide a new perspective on traditional ecology. They argue that understanding ecological complexity is crucial in today's globalized and interconnected world. Successful management of the world's ecosystems needs to combine models of ecosystem complexity with biodiversity, environmental, geographic and socioeconomic information.

The NASA Technical Reports Server (NTRS) houses half a million publications that are a valuable means of information to

researchers, teachers, students, and the general public. These documents are all aerospace related with much scientific and technical information created or funded by NASA. Some types of documents include conference papers, research reports, meeting papers, journal articles and more. This is one of those documents. Aquatic ecosystems are rich in biodiversity and home to a diverse array of species and habitats, providing a wide variety of benefits to human beings. Many of these valuable ecosystems are at risk of being irreversibly damaged by human activities and pressures, including pollution,

contamination, invasive species, overfishing and climate change. Such pressures threaten the sustainability of these ecosystems, their provision of ecosystem services and ultimately human well-being. Ecosystem-based management (EBM) is now widely considered the most promising paradigm for balancing sustainable development and biodiversity protection, and various international strategies and conventions have championed the EBM cause and the inclusion of ecosystem services in decision-making. This open access book introduces the essential concepts and principles required to

implement ecosystem-based management, detailing tools and techniques, and describing the application of these concepts and tools to a broad range of aquatic ecosystems, from the shores of Lough Erne in Northern Ireland to the estuaries of the US Pacific Northwest and the tropical Mekong Delta.

Ecosystem Dynamics

Ecosystem Modelling in the Eastern Mediterranean Sea : the Cumulative Impact of Alien Species, Fishing and Climate Change on the Israeli Marine Ecosystem

GLOBEC

National Imperatives for the Next

Decade and Beyond

Handbook of Ecological Models used in Ecosystem and Environmental Management

Seafloor Heterogeneity: Artificial Structures and Marine Ecosystem Dynamics

Firstly, I reviewed modelling approaches that were used to assess the impact of invasive alien species (IAS) in aquatic ecosystems. According to the review, multispecies/ecosystem mechanistic models dominated the applications, with dynamic and non-spatial models being the most prevalent. Most of the models included an

additional human stressor, mainly fisheries, climate change and/or nutrient loading. I summarised the main features of these applications and analysed their capabilities and limitations. Based on my conclusions, I reflected on future directions of development and applications of suitable modelling tools. The review showed that the Ecopath with Ecosim (EwE) modelling approach was frequently used to assess the impacts of already established IAS and highlighted its capabilities to forecast existing, emerging and potential new IAS. As a second step, I

developed two static Ecopath ecosystem models using the EwE approach and representing the food web of the Israeli Mediterranean coast in 1990s and 2010s. I characterized the structure and functioning of the ecosystem and assessed past and current impacts of IAS and fishing. I then used the time-dynamic Ecosim module of EwE to fit the 1990s model to available time series of observations between both periods and to explore the historical dynamics of the ecosystem considering the effects of IAS, fishing dynamics and sea warming. Finally, the time-dynamic ecosystem model

was used to analyse alternative future simulations of ecosystem change. Particularly, and after interacting with key stakeholders, I assessed the future effects of a new set of fishing regulations currently being implemented in Israel, future changes in sea temperature following IPCC (Intergovernmental Panel on Climate Change) scenario projections and the potential increases in IAS biomass. I investigated the impacts of the stressors separately, and then I combined them to evaluate their cumulative effects. Results from the static Ecopath models highlighted

that the Israeli marine ecosystem, despite productivity differences, shared some structural and functional traits with other Mediterranean ecosystems such as the dominance of the pelagic domain in term of flows, the important role of detritus through low trophic levels and the importance of the benthic-pelagic coupling. In both time periods investigated, the same keystone groups were identified with the exception of European hake in 2010s, which showed a decline in its keystone role. This may indicate that hake lost its ecological role due to population

declines. Most of the functional groups identified as keystone species were previously identified as keystones in other Mediterranean ecosystems, such as dolphins, large pelagic fishes, sharks and squids. The temporal dynamic Ecosim model indicated that trophic interactions, ocean warming and fishing were important drivers of the ecosystem dynamics. In general, temporal biomass trends revealed that native demersal predators and native medium trophic level fishes largely declined over time, while an increase over time of alien species was observed. Results from

ecological indicators suggested a degradation pattern of the ecosystem over time. Future scenarios using the temporal dynamic Ecosim model showed overall potential benefits of fishing effort reductions in the future, and detrimental impacts of increasing sea temperature and increasing biomass of alien species. Cumulative scenarios highlighted that the beneficial effects of fisheries reduction could be dampened by the impact of increasing sea temperature and alien species when acting together. These results support the need for reducing local and regional

stressors, such as fishing and biological invasions, to retain marine ecosystems within a "safe operating space" and ensure ecosystem resilience in an ongoing warming and impacted sea. Toxic chemicals can exert effects on all levels of the biological hierarchy, from cells to organs to organisms to populations to entire ecosystems. However, most risk assessment models express their results in terms of effects on individual organisms, without corresponding information on how populations, groups of species, or whole ecosystems may respond to chemical

stressors. Ecological Modeling in Risk Assessment: Chemical Effects on Populations, Ecosystems, and Landscapes takes a new approach by compiling and evaluating models that can be used in assessing risk at the population, ecosystem, and landscape levels. The authors give an overview of the current process of ecological risk assessment for toxic chemicals and of how modeling of populations, ecosystems, and landscapes could improve the status quo. They present a classification of ecological models and explain the differences between population, ecosystem,

landscape, and toxicity-extrapolation models. The authors describe the model evaluation process and define evaluation criteria. Finally, the results of the model evaluations are presented in a concise format with recommendations on modeling approaches to use now and develop further. The authors present and evaluate various models on the basis of their realism and complexity, prediction of relevant assessment endpoints, treatment of uncertainty, regulatory acceptance, resource efficiency, and other criteria. They provide models that will improve the

ecological relevance of risk assessments and make data collection more cost-effective. Ecological Modeling in Risk Assessment serves as a reference for selecting and applying the best models when performing a risk assessment.

This book presents the fundamental theories, methodologies and case studies of marine ecosystem modeling with a special focus on marine ecological dynamics that could provide scientists and researchers with a stabile and reliabile technical framework to study marine life and their developments.This book is a suitable reference for

professional and technical personnel, managers and graduate students specializing in the evolution mechanism, simulation, predication and regulation of marine ecosystems.

Managing today's lands is becoming an increasingly difficult task. Complex ecological interactions across multiple spatiotemporal scales create diverse landscape responses to management actions that are often novel, counter-intuitive and unexpected. To make matters worse, exotic invasions, human land use, and global climate change complicate this complexity

and make past observational ecological studies limited in application to the future. Natural resource professionals can no longer rely on empirical data to analyze alternative actions in a world that is rapidly changing with few historical analogs. New tools are needed to synthesize the high complexity in ecosystem dynamics into useful applications for land management. Some of the best new tools available for this task are ecological and landscape simulation models. However, many land management professionals and scientists have little expertise in simulation

modeling, and the costs of training these people will probably be exorbitantly high because most ecosystem and landscape models are exceptionally complicated and difficult to understand and use for local applications. This book was written to provide natural resource professionals with the rudimentary knowledge needed to properly use ecological models and then to interpret their results. It is based on the lessons learned from a career spent modeling ecological systems. It is intended as a reference for novice modelers to learn how to correctly employ ecosystem

landscape models in natural resource management applications and to understand subsequent modeling results.

Global Ocean Ecosystems Dynamics : a Component of the U.S. Global Change Research Program : Initial Science Plan

Large Herbivore Ecology, Ecosystem Dynamics and Conservation

Chemical Effects on Populations, Ecosystems, and Landscapes

Understanding Ecosystems Through the Transformation and Movement of Matter

Terrestrial Ecosystems in Changing Environments

Integrating Hydrology,

Ecosystem Dynamics, and Biogeochemistry in Complex Landscapes