

Biological Invasions Economic And Environmental Costs Of Alien Plant Animal And Microbe Species Second Edition

Biological invasions are one of the strongest drivers of global environmental change, and invasive species are now often in the public discourse. At the same time, economists have begun to take a real interest in determining how invasive species interact with economic systems, and how invaders should be controlled to optimize societal wealth. Although the work from ecologists and economists have both greatly expanded our understanding of the drivers and impacts of invasions, little integration between the fields has occurred that would allow managers and policy-makers to identify the optimal expenditures on, for example, prevention and control of invasive species. Because the level of effort expended on invasive species management is intricately linked to the costs and projected benefits of that management, there is an urgent need for greater synthesis between ecology and economics. This book brings ecology and economics together in new ways to address how we deal with the dynamics and impacts of invasive species, and is the outcome of many years of collaborative research between a small group of economists and ecologists. The outcome is clear demonstration of the utility of combining ecological and economic models for addressing critical questions in the management of invasive species.

This open access volume presents a comprehensive account of all aspects of biological invasions in South Africa, where research has been conducted over more than three decades, and where bold initiatives have been implemented in attempts to control invasions and to reduce their ecological, economic and social effects. It covers a broad range of themes, including history, policy development and implementation, the status of invasions of animals and plants in terrestrial, marine and freshwater environments, the development of a robust ecological theory around biological invasions, the effectiveness of management interventions, and scenarios for the future. The South African situation stands out because of the remarkable diversity of the country, and the wide range of problems encountered in its varied ecosystems, which has resulted in a disproportionate investment into both research and management. The South African experience holds many lessons for other parts of the world, and this book should be of immense value to researchers, students, managers, and policy-makers who deal with biological invasions and ecosystem management and conservation in most other regions. Invasive species constitute a significant environmental and economic threat worldwide, acting as a key driver of biodiversity loss and ecosystem function disruption globally. Biological invasions have the potential to dramatically affect species composition, guild structure and alter interspecific interactions within the invaded community. This book provides the reader with new research on invasive species. Chapter One reviews the adaptive responses of *Phalaris arundinacea*, an invasive wetland grass, to water stress. Chapter Two discusses the expansion of spider species to help better understand their potential for biological control of pests in agricultural landscapes and for conservation of biodiversity within the ecosystems in which they are found. Chapter Three explores the feasibility of using *Parkinsonia aculeata* wood as a feedstock for the sustainable development of adsorbents targeted at pollutants removal from wastewater. Chapter Four gives background information on several origins of invasive species, how invasive species respond to environmental changes, and insights on integrated management strategies that focus on enhancing species and ecosystem adaptive capacity and reducing the risks from biodiversity degradation.

Hurricanes, floods, oil spills, disease, and disappearing wetlands are some of the many environmental disasters that impact the Gulf South. The contributors to Environmental Disaster

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in the Gulf South explore the threat, frequency, and management of this region's disasters from the mid-nineteenth century to the present. Scholars from the fields of history, sociology, and anthropology examine the underlying causes of vulnerability to natural hazards in the coastal states while also suggesting ways to increase resilience. Greg O'Brien considers the New Orleans flood of 1849; Andy Horowitz, the Galveston storm of 1900; and Christopher M. Church, the 1928 hurricane in Florida and the Caribbean. Urmi Engineer Willoughby delves into the turn-of-the-century yellow fever outbreaks in New Orleans and local attempts to eradicate them, while Abraham H. Gibson and Cindy Ermus discuss the human introduction of invasive species and their long-term impact on the region's ecosystem. Roberto E. Barrios looks at political-ecological susceptibility in New Orleans's Lower Ninth Ward, and Kevin Fox Gotham treats storm- and flood-defense infrastructures. In his afterword, Ted Steinberg ponders what the future holds when the capitalist state supports an unwinnable battle between land developers and nature. These case studies offer new ways of understanding humans' interactions with the unique, and at times unforgiving, environment of the Gulf South. These lessons are particularly important as we cope with the effects of climate change and seek to build resilience and reduce vulnerability through enhanced awareness, adequate preparation, and efficient planning.

18.4 Characteristics of Top-down, Environmental Pest Management -- References -- Index -- EULA

Bioinvasion is fast becoming one of the world's most costly ecological problems, as it disrupts agriculture, drastically alters ecosystems, spreads disease, and interferes with shipping. The economic and environmental damages from alien plant, animals, and microbes in the United States, British Isles, Australia, South Africa, India, and Brazil account for more than \$300 billion per year in damages and control costs. *Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species* assembles detailed information on components of the invasive-species problem from six continents. This volume reconfirms the diverse and unpredictable roles that non-native species assume as they invade new ecosystems: destruction of vital crops and forests, major damages to ecosystems leading to loss of biodiversity, soil erosion, and water loss. In addition, it covers the impact of disease organisms on human health and livestock. Information is provided on how the non-native species invade new ecosystems and the subsequent environmental effects of these invading species. Wherever possible, estimates on the economic impacts of the invading species are included. Alien species invasions will continue to be an on-going problem in the future given human population growth, its increased needs, and its movement throughout the world. *Biological Invasions* will inform scientists, policymakers, and the public on the seriousness of non-native species invasions that cause extinction as well as significant costs to the environment, economy, and public health. About the Editor: David Pimentel is well respected worldwide for a life of work in the Agricultural and Environmental Sciences. His research and consulting accomplishments cut across traditional disciplinary boundaries. Dr. Pimentel has served on numerous Presidential Commissions and National Academy of Sciences' Committees and Boards. He has authored nearly 600 scientific publications, written two books, and edited 20 books.

Governments respond to increased phytosanitary risks by imposing trade-restricting measures. This pioneering encyclopedia illuminates a topic at the forefront of global ecology—biological invasions, or organisms that come to live in the wrong place. Written by leading scientists from around the world, *Encyclopedia of Biological Invasions* addresses all aspects of this subject at a global level—including invasions by animals, plants, fungi, and bacteria—in succinct, alphabetically arranged articles. Scientifically uncompromising, yet clearly written and free of jargon, the volume encompasses fields

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of study including biology, demography, geography, ecology, evolution, sociology, and natural history. Featuring many cross-references, suggestions for further reading, illustrations, an appendix of the world's worst 100 invasive species, a glossary, and more, this is an essential reference for anyone who needs up-to-date information on this important topic. Encyclopedia of Biological Invasions features articles on: • Well-known invasive species such the zebra mussel, chestnut blight, cheatgrass, gypsy moth, Nile perch, giant African snail, and Norway rat • Regions with especially large numbers of introduced species including the Great Lakes, Mediterranean Sea, Hawaiian Islands, Australia, and New Zealand. • Conservation, ecological, economic, and human and animal health impacts of invasions around the world • The processes and pathways involved in invasion • Management of introduced species

'An interesting book catering perhaps for a more specific audience. It does however provide a somewhat new view of the problems of the field of biological invasions and is worth the effort.' - Ann Sundqvist, M2 Best Books 'Once again, Charles Perrings and colleagues have broken new ground by applying economic and ecological analysis to the very real problem of biological invasions. This is path-breaking work in what promises to be a new sub-discipline within environmental economics.' - David Pearce, University College London, UK Biological invasions - the introduction of living organisms beyond their original range - are one of the main drivers of biodiversity loss. They are a major threat to human health and a source of pests and pathogens in the world's farms, forests and fisheries. The growth of international trade and travel means that more species are being introduced to more places than ever before. This book represents the first concerted effort to understand the economic causes and consequences of biological invasions. The volume discusses the theoretical and methodological issues raised by invasion, including control strategies, modelling options, and a study of the economic, institutional and policy conditions that predispose countries to biological invasions. Also included are case studies of fisheries, agricultural systems, tropical forests and protected areas affected by invasive species in locations such as the Black Sea, Australia and Africa, and an evaluation of control programmes. The impact of invasive species is second only to that of human population growth and associated activities as a cause of the loss of biodiversity throughout the world. In the United States, invasions of nonnative plants, animals, or microbes cause major environmental damage. The second edition of Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species represents the most current, single-source reference containing scientific and economic information on this timely subject. This volume reconfirms the diverse and unpredictable roles that non-native species assume as they invade new ecosystems: destruction of vital crops and forests, major damages to ecosystems leading to loss of biodiversity, soil erosion, and water loss. The text provides information on how the non-native species invade new ecosystems, their subsequent environmental effects, and estimates on economic impacts. Biological Invasions supplies scientists, policymakers, and the public with a better understanding of the invading species and how to prevent their spread and improve control procedures.

Biological invasions are a severe ecological problem threatening biodiversity and causing substantial economic damages. Mathematical models of spatiotemporal spread have proven to be powerful tools in identifying the underlying mechanisms, thus

contributing to the understanding of the factors that determine invasion processes and to the assessment of possible control methods. In this thesis, classical models are extended to combine spatial spread, population growth, disease transmission and community interactions. Applications are exemplarily found in the circulation of the Feline Immunodeficiency Virus (FIV) - an HIV-similar lentivirus that induces AIDS in cat populations - and in viral infections in phytoplankton that forms the basis for all food chains and webs in the sea. The joint interplay of epidemics, predation and environmental stochasticity in invasion models is shown to generate rich and novel patterns of spatiotemporal spread such as the blocking and reversal of invasion fronts or the spatial 'trapping' of infection as well as its noise-induced escape. The results of this thesis can explain real-world phenomena and have important implications for understanding and controlling invasion processes in ecosystems and epidemiology.

Volume One of the thoroughly revised and updated guide to the study of biodiversity in insects The second edition of *Insect Biodiversity: Science and Society* brings together in one comprehensive text contributions from leading scientific experts to assess the influence insects have on humankind and the earth's fragile ecosystems. Revised and updated, this new edition includes information on the number of substantial changes to entomology and the study of biodiversity. It includes current research on insect groups, classification, regional diversity, and a wide range of concepts and developing methodologies. The authors examine why insect biodiversity matters and how the rapid evolution of insects is affecting us all. This book explores the wide variety of insect species and their evolutionary relationships. Case studies offer assessments on how insect biodiversity can help meet the needs of a rapidly expanding human population, and also examine the consequences that an increased loss of insect species will have on the world. This important text: Explores the rapidly increasing influence on systematics of genomics and next-generation sequencing Includes developments in the use of DNA barcoding in insect systematics and in the broader study of insect biodiversity, including the detection of cryptic species Discusses the advances in information science that influence the increased capability to gather, manipulate, and analyze biodiversity information Comprises scholarly contributions from leading scientists in the field *Insect Biodiversity: Science and Society* highlights the rapid growth of insect biodiversity research and includes an expanded treatment of the topic that addresses the major insect groups, the zoogeographic regions of biodiversity, and the scope of systematics approaches for handling biodiversity data.

When organisms are deliberately or accidentally introduced into a new ecosystem a biological invasion may take place. These so-called 'invasive species' may establish, spread and ecologically alter the invaded community. Biological invasions by animals, plants, pathogens or vectors are one of the greatest environmental and economic threats and, along with habitat destruction, a leading cause of global biodiversity loss. In this book, more than 50 worldwide invasion scientists cover our current understanding of biological invasions, its impacts, patterns and mechanisms in both aquatic and terrestrial systems.

How will biodiversity loss affect ecosystem functioning, ecosystem services, and human well-being? In an age of accelerating biodiversity loss, this timely and critical volume summarizes recent advances in biodiversity-ecosystem functioning research and explores the economics of biodiversity and ecosystem services. The book starts by

summarizing the development of the basic science and provides a meta-analysis that quantitatively tests several biodiversity and ecosystem functioning hypotheses. It then describes the natural science foundations of biodiversity and ecosystem functioning research including: quantifying functional diversity, the development of the field into a predictive science, the effects of stability and complexity, methods to quantify mechanisms by which diversity affects functioning, the importance of trophic structure, microbial ecology, and spatial dynamics. Finally, the book takes research on biodiversity and ecosystem functioning further than it has ever gone into the human dimension, describing the most pressing environmental challenges that face humanity and the effects of diversity on: climate change mitigation, restoration of degraded habitats, managed ecosystems, pollination, disease, and biological invasions. However, what makes this volume truly unique are the chapters that consider the economic perspective. These include a synthesis of the economics of ecosystem services and biodiversity, and the options open to policy-makers to address the failure of markets to account for the loss of ecosystem services; an examination of the challenges of valuing ecosystem services and, hence, to understanding the human consequences of decisions that neglect these services; and an examination of the ways in which economists are currently incorporating biodiversity and ecosystem functioning research into decision models for the conservation and management of biodiversity. A final section describes new advances in ecoinformatics that will help transform this field into a globally predictive science, and summarizes the advancements and future directions of the field. The ultimate conclusion is that biodiversity is an essential element of any strategy for sustainable development.

Over the past century, the number of species that have been transported to areas outside their native range has increased steadily. New pests and pathogens place biological pressure on valuable resident species, but strict bans may conflict with trading and travel needs. An overview of how the conflict can be managed using pest risk mapping and modelling, this book uses worked examples to explain modelling and help development of tool kits for assessment.

In recent years invasive species became a hot topic and biological invasions by alien species as one of the major threats to indigenous or native biodiversity in almost every country in the world. It was highly acknowledged by scientists and researchers. Therefore invaders are recognized as one of the major environmental problem globally. Sri Lanka is a small tropical island enriched with variety of unique ecosystems. Today several ecosystems of Sri Lanka have been affected by biological invasions affecting on environment and human life, such as biodiversity, agriculture and human health, social, cultural, economic and ecological processes. In order to manage the invaders one should require details of its distribution and rate of spreading and the best practices of controlling applications. This work is first attempt to map the "Myroxylon balsamum (L.) Harms" spread in Udawattakele Forest in Kandy district, Sri Lanka. The work intended to provide the forest manages vital information on the priority areas of controlling and managing of this invader and also this work will be very important for researchers, students who are studying GIS and Remote Sensing and Environment fields.

INVASIVE ALIEN SPECIES Invasive Alien Species: Observations and Issues from Around the World Volume 1: Issues and Invasions in Africa Invasive alien species are

spreading into new ecosystems each year. The impacts caused by these invaders can be swift and devastating. The topic of invasive alien species is large, complex, and globally significant at various scales, exacerbated by the globalization of world economies and increased trade and commerce that has overcome natural barriers to species movement. Invasive alien species threaten global food supplies, water quality and availability, and energy production and delivery. With the added risks associated with global climate change, the global homogenization of plants, animals, and microbes is a major factor in the decline in ecosystem health and ecosystem services worldwide. To counter this trend, there is a critical need to unify governments, cultures, and programs to improve cross-boundary coordination to effectively address the wide range of invasive alien species threats to the environment, economies, and to plant and animal health; particularly human health. This 4-volume work is the first to compile a set of useful material for key topics, to provide a better understanding of the overall global threat of invasive alien species and the diverse array of problems faced around the world, and assemble material that includes potential replicable solutions to overcome these threats. The books also highlight the threat posed by invasive alien species in terms of a global 'call to action'. Since invasive species know no boundaries, it is our hope that by compiling material from different scientific and social perspectives around the world, and sharing knowledge and examples of a diverse array of associated topics, we can advance global awareness and improve unified national responses to the threat posed by invasive alien species.

Invasive species have a critical and growing effect upon natural areas. They can modify, degrade, or destroy wildland ecosystem structure and function, and reduce native biodiversity. Landscape-level solutions are needed to address these problems. Conservation biologists seek to limit such damage and restore ecosystems using a variety of approaches. One such approach is biological control: the deliberate importation and establishment of specialized natural enemies, which can address invasive species problems and which should be considered as a possible component of restoration. Biological control can be an effective tool against many invasive insects and plants but it has rarely been successfully employed against other groups. Safety is of paramount concern and requires that the natural enemies used be specialized and that targeted pests be drivers of ecological degradation. While modern approaches allow species to be selected with a high level of security, some risks do remain. However, as in all species introductions, these should be viewed in the context of the risk of failing to reduce the impact of the invasive species. This unique book identifies the balance among these factors to show how biological control can be integrated into ecosystem restoration as practiced by conservation biologists. Jointly developed by conservation biologists and biological control scientists, it contains chapters on matching tools to management goals; tools in action; measuring and evaluating ecological outcomes of biological control introductions; managing conflict over biological control; and includes case studies as well as an ethical framework for integrating biological control and conservation practice. Integrating Biological Control into Conservation Practice is suitable for graduate courses in invasive species management and biological control, as well as for research scientists in government and non-profit conservation organizations.

Human colonization of New Zealand has dramatically altered the resident biota,

introduced numerous alien organisms to these once remote islands, and exported local species to the world. This book reviews invasions, investigates what controls the success of invaders and studies the consequences for ecosystems both on land and offshore. The book tests current theories about the success of invaders and evaluates principles for effective management of biological invasions worldwide.

Biosecurity is the assessment and management of potentially dangerous infectious diseases, quarantined pests, invasive (alien) species, living modified organisms, and biological weapons. It is a holistic concept of direct relevance to the sustainability of agriculture, food safety, and the protection of human populations (including bio-terrorism), the environment, and biodiversity. Biosecurity is a relatively new concept that has become increasingly prevalent in academic, policy and media circles, and needs a more comprehensive and inter-disciplinary approach to take into account mobility, globalisation and climate change. In this introductory volume, biosecurity is presented as a governance approach to a set of concerns that span the protection of indigenous biological organisms, agricultural systems and human health, from invasive pests and diseases. It describes the ways in which biosecurity is understood and theorized in different subject disciplines, including anthropology, political theory, ecology, geography and environmental management. It examines the different scientific and knowledge practices connected to biosecurity governance, including legal regimes, ecology, risk management and alternative knowledges. The geopolitics of biosecurity is considered in terms of health, biopolitics and trade governance at the global scale. Finally, biosecurity as an approach to actively secure the future is assessed in the context of future risk and uncertainties, such as globalization and climate change. The accelerating rates of international trade, travel, and transport in the latter half of the twentieth century have led to the progressive mixing of biota from across the world and the number of species introduced to new regions continues to increase. The importance of biogeographic, climatic, economic, and demographic factors as drivers of this trend is increasingly being realized but as yet there is no consensus regarding their relative importance. Whereas little may be done to mitigate the effects of geography and climate on invasions, a wider range of options may exist to moderate the impacts of economic and demographic drivers. Here we use the most recent data available from Europe to partition between macroecological, economic, and demographic variables the variation in alien species richness of bryophytes, fungi, vascular plants, terrestrial insects, aquatic invertebrates, fish, amphibians, reptiles, birds, and mammals. Only national wealth and human population density were statistically significant predictors in the majority of models when analyzed jointly with climate, geography, and land cover. The economic and demographic variables reflect the intensity of human activities and integrate the effect of factors that directly determine the outcome of invasion such as propagule pressure, pathways of introduction, eutrophication, and the intensity of anthropogenic disturbance. The strong influence of economic and demographic variables on the levels of invasion by alien species demonstrates that future solutions to the problem of biological invasions at a national scale lie in mitigating the negative environmental consequences of human activities that generate wealth and by promoting more sustainable population growth.

Invasive alien species are a major threat to biodiversity and ecosystems throughout the world. In India, a country with four of the world's most important 'biodiversity hotspots',

the invasion of alien plants means risking a national ecological disaster with major social and economic consequences. Currently, there is insufficient information about invasive alien plants; their distribution, rate of spread and adaptability to new environments. This book reveals existing and potential invaders, evaluates the level of risk they pose to native species and suggests steps to manage spread and limit damage. Invaluable to policy-makers, this book is also required reading for researchers of invasive plants worldwide.

This book investigates the mathematical analysis of biological invasions. Unlike purely qualitative treatments of ecology, it draws on mathematical theory and methods, equipping the reader with sharp tools and rigorous methodology. Subjects include invasion dynamics, species interactions, population spread, long-distance dispersal, stochastic effects, risk analysis, and optimal responses to invaders. While based on the theory of dynamical systems, including partial differential equations and integrodifference equations, the book also draws on information theory, machine learning, Monte Carlo methods, optimal control, statistics, and stochastic processes. Applications to real biological invasions are included throughout. Ultimately, the book imparts a powerful principle: that by bringing ecology and mathematics together, researchers can uncover new understanding of, and effective response strategies to, biological invasions. It is suitable for graduate students and established researchers in mathematical ecology.

Introductions of biological invaders are often a consequence of economic activity or human action. Invasive species and pathogens pose significant threats to both the environment and society. Preventing and managing invaders is an interdisciplinary problem; it cannot be achieved solely through use of economic analysis nor just consideration of system biology or ecology. Human action and the environmental responses are interconnected and should be studied as such. Proper specification of models to address prevention and management require an understanding of species biology and system ecology, which are both influenced by human and environmental factors. This dissertation presents three essays on the economics of prevention and management of biological invasions with an emphasis on how space plays a role in introduction drivers and damage magnitudes. The questions addressed herein require consideration of biological, ecological, and economic processes to inform prevention and control policy. The first two essays explore the consequences of ignoring health risks resulting from land use change over time and space. The third essay addresses producer response to heterogeneous contamination risk in live animal input markets. The concept that a number of infectious diseases such as malaria, Ebola, and Zika virus are linked to changes in anthropogenic land use is becoming widely known and accepted. However, infectious disease is rarely considered as a cost in land use decision-making. Chapter 1 develops a model that includes the health consequences of land conversion decisions. A dynamic harvest model is used to determine an optimal rate and area of land conversion that accounts for the benefits and consequences of environmental conversion, including increased prevalence of malaria. Simulations indicate the cost of ignoring the change in malaria prevalence as a consequence of land use change can create significant welfare losses and that this ignored cost of conversion should be factored into policy making. The second chapter builds on the results of Chapter 1; health consequences arising from land use change are great

enough to alter the net benefits of land conversion. Chapter 2 addresses whether risk of infectious disease modifies the optimal patterns and timing of land conversion. The dynamic model developed in this chapter allows for different time paths and areas of conversion across land units or regions, where any differences in conversion patterns are driven by spatial orientation of the land units. When the costs of infectious disease are correlated with patterns of land conversion, the optimal sites of land conversion are altered. Location of conversion can be used as a first step in mitigating health risks of altered landscapes and the patterns are dependent on magnitude of the disease costs. The results of this chapter are consistent with recommendations of ecologists and epidemiologists to strategically select conversion patterns by considering the ecological impacts of land use decisions. Chapter 3 models producer response to information about contamination risk in live animal import markets. Trade and movement of live animals and animal products drive the introduction and spread of a number of zoonotic and livestock diseases. Existing trade policies are geared toward minimizing the risk of introducing a pest or pathogen by banning imports from specific sources.

Understanding how agents behave in a decentralized environment can give insight into how to create targeted policies for minimizing risk. The model examines the trade-offs faced by importers when choosing where to source live and risky inputs to production. Simulations using data from the live cattle trade industry give insight into how and when importers substitute away from high-risk sources. The magnitude of substitution varies by the amount of information the importer uses in its risk estimation. The value to risk trade-off can be measured as an elasticity, detailing how individual producers respond to risk. Simulations indicate providing producers with more detailed information sets to determine the expected damages of import decisions reduces system costs and improves welfare over strict bans on trade.

The papers in this book are based on efforts by an international group of soil ecologists to assess the biological and ecological mechanisms of earthworm invasions. They examine their geographic extent and impacts on terrestrial ecosystems, and possible means by which earthworm invasions might be mitigated. The book broadens the discussion on invasion biology and ecology to belowground systems.

Good biosecurity policy decisions, particularly in relation to plant industry protection, are of ever increasing importance. Growth in the speed and diversity of trade, the effects of climate change and the resultant spread of pests and diseases continue to highlight this. This book contains an introduction to the issues confronting plant biosecurity policymakers and how the economic risks of invasive species can be assessed over time. It describes both probability models that show what might happen if species 'invade' a region and values models that help decide what management actions should be taken. As the first book of its kind focusing on a comprehensive range of policies, case studies and applications, Plant Biosecurity Policy Evaluation is perfect for biosecurity policy makers, decision-support specialists, advanced students of agricultural studies, public policy and invasive species research.

This two-volume set provides an authoritative overview of the major environmental issues of the 21st century, with a special focus on current challenges, trends, and policy choices. This set provides an up-to-date, comprehensive, and focused resource for understanding the nature and scope of environmental challenges facing the United States and the world in the 21st century, as well as options for meeting those

challenges. Volume One covers environmental trends and challenges within the United States, while Volume Two illuminates environmental issues and choices around the world. Issues covered in both volumes include vital topics such as climate change, air and water pollution, natural resource and species protection, and agricultural/industrial impacts on the environment and public health. For all topics, the authors—scholars and experts hailing from a wide range of environmental and policy fields—detail a range of political, social, and economic options for the future and explain why the issue in question is important for society and people as well as the natural world. User-friendly division of volumes into U.S. and international coverage Authoritative and objective analysis from environmental scholars Illuminating sidebars providing case studies about important environmental trends and policies Lists of issue-specific resources for further research

'An interesting book catering perhaps for a more specific audience. It does however provide a somewhat new view of the problems of the field of biological invasions and is worth the effort.' - Ann Sundqvist, M2 Best Books 'Once again,

"Invasive species cause substantial ecological and economic damages. While major modelling improvements have been made in the last decades, predictions are primarily based on single species analyses, look at a single factor at a time (i.e. environmental conditions, species traits, and propagule pressure, individually), and consider quite broad stages (e.g., establishment), which may be usefully resolved into smaller sub-stages. Further, although models arguably provide the most coherent, sophisticated predictions, most quantitative models remain unused in policy-oriented invasive species risk assessments, which largely rely on expert-opinion and simple summation across individual factors believed to influence invasions (i.e. scoring-based approaches). Of course, for quantitative analyses, data limitations typically exist. To allow quantitative methods to be even more powerful and broadly usable, approaches are needed to alleviate those limitations and optimally use the available information. In this thesis, I advance the field of invasion biology, contributing to each of the three issues identified above. In Chapter 1, I consider the three main predictors of biological invasions: environment, propagule pressure and species traits, and I integrate these into a coherent multispecies, geographically explicit model. I show the importance of their combination, and forecast that, for the aquarium fish invasion pathway, "the rich get richer" in that the most vulnerable current locations are likely to suffer the greatest increase in new invasions in the future. By employing an integrative approach and a multispecies perspective, this work provides support to decision making for resource managers and policy makers, and a better understanding of non-indigenous species establishment. In Chapter 2, I recognize that while prevention may be ideal, it is not always achievable, and prioritizing rapid responses is necessary for the effective management of potentially harmful non-indigenous species. To address issues of rapid response, we need to more finely resolve the establishment phase of biological invasions, and determine what happens after a new species has been detected (i.e. whether long-term persistence occurs). In this chapter, I have three objectives: 1)

I separate casual (i.e. temporary) establishment and persistence (i.e. lack of subsequent extirpation), using the framework developed in Chapter 1 to generate a multispecies, geographically explicit model to prioritize rapid response efforts; 2) recognizing that mathematical models often remain unused in policy, I convert the model parameters into simple multiplicative risk factors, to facilitate broader adoption outside the modelling field; 3) from a fundamental perspective, I show that propagule pressure is important for casual establishment, but does not help predict subsequent persistence. Species traits are the most important group of predictors for casual establishment, while the environment is most relevant for persistence. In Chapter 3, I develop an approach to more powerfully use available data (focusing on species traits). From Chapters 1 and 2, it became apparent that about 80% of trait values were missing in the trait database used (FishBase). Thus, I develop a novel, fast, simple method for imputation, based on trait Correlation, taxonomic Relatedness and Uncertainty minimization (CRU). I compare it against existing cutting edge approaches, and show that CRU was the most accurate. Additionally, I consider and demonstrate that including CRU into an ensemble model combining existing techniques (Phylopars and missForests) yields even greater accuracy. This work fills in a substantial subset of FishBase, but also provides an approach for the imputation of other trait databases. Overall, this thesis advances understanding of ecological processes and informs environmental management while using the best available information"-- Biological Invasions Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species, Second Edition CRC Press

Biological invasions are considered to be one of the greatest threats to the integrity of most ecosystems on earth. This volume explores the current state of marine bioinvasions, which have been growing at an exponential rate over recent decades. Focusing on the ecological aspects of biological invasions, it elucidates the different stages of an invasion process, starting with uptake and transport, through inoculation, establishment and finally integration into new ecosystems. Basic ecological concepts - all in the context of bioinvasions - are covered, such as propagule pressure, species interactions, phenotypic plasticity, and the importance of biodiversity. The authors approach bioinvasions as hazards to the integrity of natural communities, but also as a tool for better understanding fundamental ecological processes. Important aspects of managing marine bioinvasions are also discussed, as are many informative case studies from around the world.

& Quot;Plant Sciences Reviews 2011" provides scientists and students in the field with timely analysis on key topics in current research. Originally published online in CAB Reviews, this volume makes available in printed form the reviews in plant sciences published during 2011.

The consequences of the introduction and spread of invasive alien species in non-native ecosystems is an area of growing interest for international policymakers and regulators. Globalisation has increased the rate and magnitude of biological

invasions, resulting in huge environmental, economic and social costs. Until recently, the effectiveness of international efforts to provide a coordinated response to the threat of alien invasions have been limited. This book considers the existing Multilateral Environmental Agreements and looks at the potential role of regional environmental governance, particularly in consideration of the adoption of the European Parliament and Council regulation 1143/2014 on the management and control of invasive species, to provide an effective response to this global threat.

Researchers have shown increasing interest in biological invasions for the associated ecological and economic impacts as well as for the opportunities they offer to study the mechanisms that induce range expansion in novel environments. I investigated the strategies exhibited by invasive species that facilitate range expansion. Invasive populations exhibit shifts in life-history strategy that may enable appropriate responses to novel biotic and abiotic factors encountered during range expansion. The spatio-temporal scales at which these shifts occur are largely unexplored. Furthermore, it is not known whether the observed dynamic shifts represent a consistent biological response of a given species to range shifts, or whether the shifts are affected by the abiotic characteristics of the new systems. I examined the life-history responses of female round gobies *Neogobius melanostomus* across fine and coarser spatial scales behind the expansion front and investigated whether invasive populations encountering different environmental conditions (Ontario vs France) exhibited similar life-history shifts. In both study systems, I found an increase in reproductive investment at invasion fronts compared to longer established areas at coarse and fine scales. The results suggest a similar response to range shifts, or a common invasion strategy independent of environmental conditions experienced, and highlight the dynamic nature of an invasive population's life history behind the invasion front. The second part of my research focused on the development of an appropriate eDNA method for detecting invasive species at early stages of invasion to enable early detection and rapid management response. I developed a simple, inexpensive device for collecting water samples at selected depths for eDNA analysis, including near the substrate where eDNA concentration of benthic species is likely elevated. I also developed a protocol to optimise DNA extraction from water samples that contain elevated concentration of inhibitors, in particular near-bottom samples. Paired testing of eDNA and conventional surveys was used to monitor round goby expansion along its invasion pathway. Round gobies were detected in more sites with eDNA, permitting earlier, more accurate, upstream detection of the expansion front. My study demonstrated the accuracy and the power of using eDNA survey method to locate invasion fronts. Key words: Age-specific reproductive investment; DNA extraction; fecundity; energy allocation; invasion front; range expansion; reproductive effort.

This new volume on Biological Invasions deals with both plants and animals,

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differing from previous books by extending from the level of individual species to an ecosystem and global level. Topics of highest societal relevance, such as the impact of genetically modified organisms, are interlinked with more conventional ecological aspects, including biodiversity. The combination of these approaches is new and makes compelling reading for researchers and environmentalists.

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