Topics in Biodiversity and Conservation 20

Florencia Montagnini *Editor*

Biodiversity Islands: Strategies for Conservation in Human-Dominated Environments

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Biodiversity Islands: Strategies for Conservation in Human-Dominated Environments

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This book is dedicated to my father.

Foreword

It is unfortunate that a book on this topic needed to be written, but it is on a highly relevant subject given the worldwide destruction of natural habitats and the loss of so many biological species. As we, at present, face the sixth great species extinction, the remaining biodiversity survive in small patches or islands, which have become extremely important for the survival of the species they contain or the migrant birds they host. As someone who has worked a lifetime in botanical gardens, I am very aware of the small patches of original vegetation that they often contain and their value for the pollinators that visit the flowers or the occasional visit of migratory birds as they pause on their journey. At the Royal Botanical Gardens at Kew in London, there is rare-listed hoverfly and an endangered species of lichen among other species preserved in this biodiversity island. In my field work in the highly fragmented Atlantic rainforest of Brazil and Argentina, we are still finding new and undescribed species of plants in the small remnants of the original forest. It is fortunate that still many species of animals and plants survive in these often small islands, making them extremely important, and a book drawing attention to them is most welcome.

Until relatively recently, much more attention was given to marine islands following the work of MacArthur and Wilson in 1967 and because of their much-threatened biodiversity, but now there is a growing realisation of the importance of human-made islands on the mainland. The creation of biodiversity islands has been the topic of important research in the Biological Dynamics of Forest Fragments Project near Manaus, Brazil. I have spent many hours identifying plant species for this project. The original name of the project "Minimum Critical Size of Ecosystems Project" indicates its original research purpose to provide data about the minimum area needed to preserve a functioning area of rainforest to assist in the establishment of reserves and conservation areas. This book clearly demonstrates that today there are biodiversity islands of many different sizes, shapes and purposes.

This book treats a great variety of different types of biodiversity islands, all of which are areas of high biodiversity surrounded by highly degraded or intensely

used landscapes that act as refuges for the surviving species of the original ecosystem. The many examples given here clearly show the critical importance of biodiversity islands for conservation, restoration and sustainable management of several productive agroforestry systems. It is good to be taken around the world with examples of biodiversity islands in both the tropical and the temperate regions. I like the fact that these examples include not only areas of pristine natural habitats such as the Monteverde Cloud Forest in Costa Rica or the forest islands in the Paraguayan Chaco but also several examples from highly managed islands in agroforestry and regenerative agriculture systems. Some of the examples of the policies and political motivations given in various chapters should be helpful to anyone involved in the creation or management of a biodiversity island. Several chapters here show examples of harmonising food production with conservation. This unity of purpose is important and is far more likely to be of long-term success than placing conservation and agriculture in separate camps. Several chapters show the importance of alternative ways to produce food from more integrated management systems that also preserve biodiversity. The social, ecological, ethical and economic benefits of such systems are clearly outlined in several of the chapters.

I congratulate the editor of this book for gathering together such a varied and useful compilation of the ongoing work on biodiversity islands. This will be of considerable use to people involved in the design of future biodiversity islands because it has much to say about the motivations and politics and also about their size and spatial distribution whether from fragments of the original vegetation or from restoration of degraded and intensely used areas. It will be a most useful tool for both conservation and restoration. My hope is that this will be used by conservation organisations, local communities and indigenous peoples to create effective islands of biodiversity in many different ecosystems of the world and for many more creative types of management.

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Preface

A biodiversity island is an area of high biodiversity located within ecologically degraded, human-dominated landscapes. Biodiversity in the "islands" exceeds the surrounding landscape biodiversity baseline. These biodiversity islands thereby act as ecological refuges, promoting restoration and conservation in altered ecosystems prevalent today throughout the globe.

Biodiversity islands can provide food, water, fuels, and fibers, as well as genetic, medicinal, biochemical, and ornamental resources, pollination services, biological pest control, and maintenance of life cycles of migratory species. These landscapes hold promise for protecting a multitude of plant and animal species for present and future generations. The presence of biodiversity islands spread over a large area can decrease the chances of habitat loss from fire, disease, and other disturbances.

Biodiversity islands can exist within a wide range of human-dominated landscapes, including forest, agricultural, and urban settings, and can vary in scale from square meters to thousands of square kilometers. Design strategies for biodiversity islands depend on the spatial distribution of reserves throughout the landscape, the degree of site degradation, the species present, and their locations within the urban to rural spectrum.

This book is intended to provide an overview for the identification and establishment of biodiversity islands, presenting examples and case studies where the biodiversity islands approach is being used in a variety of locations and contexts worldwide. This book will contribute to design parameters on appropriate sizing and spatial distribution of biodiversity islands to be effective in conservation and regeneration across the landscape, using integrated landscape management approaches.

The chapters discuss current challenges faced today by biodiversity conservation researchers, practitioners, and policy makers and propose innovative approaches to tackle them. Contributors are an assemblage of researchers, academicians, and practitioners from biodiversity conservation, environmental management, forestry, agroecology, agroforestry, and related fields who approach the issues from unique perspectives.

This book comprises five parts: **Part I, Introduction**, establishes the framework for understanding the complexities of biodiversity islands and the variety of strategies that can be used to establish them. The Introduction defines the term "biodiversity islands" and their size, location, and distribution in the landscape; stresses their many ecological, social, and economic benefits; and discusses potential limitations of the use of this framework along with ways to overcome them. **Part II, Biodiversity Islands Establishment and Management: Challenges and Alternatives,** shows how design strategies may depend on landscape use within the matrix of habitat fragmentation, with integrated landscape management (ILM), including sustainable agriculture, agroforestry, and community-led action, providing a framework for implementation. **Part III, Biodiversity Islands Across the Globe: Case Studies,** shows how varied agroecological strategies were applied in the formation or conservation of biodiversity islands in human-dominated landscapes in Paraguay, Peru, Costa Rica, Colombia, Great Britain, Argentina, Panama, and the USA. The variety of case studies from different types of landscapes from several regions of the world reveals the role biodiversity islands play in conserving local flora and fauna that have been largely diminished by anthropogenic activities, while providing cultural connections to nature and supplying ecosystem services that make biodiversity islands advantageous to farmers and nearby communities. **Part IV, Safeguarding the Environmental, Economic, and Social Benefits of Biodiversity Islands,** further details the economic, social, political, and cultural aspects of the establishment and persistence of biodiversity islands in anthropogenic landscapes, emphasizing how community-led action contributes to their development and subsequent management, with examples from Puerto Rico, Ecuador, Brazil, India, the USA, Panama, and Ethiopia. **Part V**, **Conclusions**, summarizes the lessons learned while compiling this volume and lays out the pending challenges and potential solutions ahead.

One late summer afternoon, about 2 years ago, while relaxing in the porch of a house in suburban/rural Northford, Connecticut, a fox ran across the garden, apparently not feeling too threatened by our presence. When wondering where this small animal was coming from, and where did it go when it finally ran away, Kjell E Berg suggested that the water reservoir located about 100 meters from the house was a nice undisturbed forest that perhaps was functioning as a biodiversity island. Soon the idea of digging more into the concept grew in all directions; the next day, Brett Levin at Yale enthusiastically took it as his own project, and soon we wrote the introductory chapter of this book among the three of us.

Other ideas followed as we developed a website: https://biodiversityislands.org/ and led a meeting session called "Biodiversity Islands: Pockets of Protected Land in Human Dominated Environments" at a IUFRO (International Union of Forest Research Organizations) conference in Posadas, Misiones, Argentina, in October 2018. The structure and contents of this book further developed as we met and held conversations with students, colleagues, and friends whose enthusiasm, energy, and joyful attitude made this book possible from start to end. The more than a 100 authors who contributed chapters for this book drove the rest of the way with their

dynamism, dedication, and persistence. Numerous colleagues and friends also helped with their intellectual input and moral support.

There was a total of 105 contributors from 11 countries (32 Argentina; 2 Brazil; 1 Canada; 14 Colombia; 2 Costa Rica; 10 Mexico; 4 Panama; 11 Paraguay; 3 Peru; 23 USA; 2 UK). Different chapters report research, case studies, and experiences from 14 countries: Argentina, Brazil, Colombia, Costa Rica, Ecuador, Ethiopia, India, Mexico, Panama, Paraguay, Peru, Puerto Rico, the UK, and the USA. Thus, the book includes examples of biodiversity islands from tropical as well as temperate regions, ranging from natural habitats to agroforestry and regenerative agriculture systems, and from relatively small to large geographic areas of the world.

A holistic, multidisciplinary perspective was taken in approaching each theme, encompassing factors and variables from multiple disciplines. The contributing authors present views from the academic, practitioner, and policy-making perspectives, offering alternatives and suggestions for promoting strategies that support biodiversity conservation through intentionally designed frameworks for sustainable forest landscapes. With the current worldwide trend of habitat destruction and the need to preserve biodiversity and its values, this book is an essential tool as it provides suggestions and concrete examples that can be used by a variety of stakeholders in various settings throughout the world. This book is useful to researchers, farmers, foresters, landowners, land managers, city planners, and policy makers alike.

New Haven, CT, USA Florencia Montagnini

Acknowledgments

Many chapter contributors acted as independent reviewers of other colleagues' chapters. In addition, other external reviewers generously gave their time to read and offer useful suggestions to improve the chapters. There was a total of 55 reviewers from the academic as well as from the practitioner's realms. The following is a list of chapter reviewers: Oscar J Abelleira, Dara Albrecht, Victor Arroyo-Rodriguez, Gary Bentrup, Kjell E Berg, Robert Bushbacher, Jonathan Cornelius, Sara del Fierro, Beatriz Eibl, Alberto Esquivel, Ben Everett-Lane, Glenn Galloway, Sergius Gandolfi, Eva Garen, Libertario González, Heather Griscom, David Hawksworth, Karen Kainer, Keith Kirby, B. Mohan Kumar, Rafaela Laino Guanes, Ariel Lugo, Brett Levin, Philip Marshall, Paula Meli, Zoyla Mireya Clavo Peralta, Irene Montes-Londoño, Gabriela Morales-Nieves, Mathew Moran, Carlos Navarro, Quint Newcomer, Fernando Niella, Joseph Orefice, Alison Ormbsy, Nahuel Pachas, Pablo Peri, Daniel Piotto, Julio Prieto, Neptali Ramírez-Marcial, Juan Rivero de Aguilar, Carmen María Rojas González, Ricardo Rozzi, Rocío Santos-Gally, John Schelhas, Sara Scherr, Emily Sigman, Jacob Slusser, Ryan Smith, Rosina Soler, Eric Toensmeier, Mateo Vega, Zoe Volenec, Sheila Ward, Catherine Watson, and Gustavo Zuleta. Many thanks to them for their generosity and dedication.

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Financial, logistical, and administrative support from Yale School of the Environment (YSE) made this book possible.

Finally, this book was written to soothe the grief of losing Sunset, constant and faithful companion whose energy, strength, and perseverance were always contagious and made the ride through life smooth and enjoyable for so many years.

Northford and New Haven, CT, USA Florencia Montagnini
June 12, 2021

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About the Editor

Florencia Montagnini has over 30 years of experience researching and teaching in topics on sustainability of managed ecosystems in the tropics, such as forest, tree plantations, and agroforestry systems, with a special emphasis on Latin America. Her work as a scientific advisor and consultant has also taken her to Africa and South East Asia. Her research encompasses sustainable land-use systems that integrate ecological principles with economic, social, and political factors; the principles and applications of forest landscape restoration; the reforestation of degraded lands with native species; identification and quantification of ecological services (biodiversity, carbon sequestration, and watershed protection); organic farming using indigenous resources; biodiversity conservation in human-dominated landscapes; and biodiversity islands. She received her BS in agronomy from the National University of Rosario, Argentina; her master's degree in ecology from the Venezuelan Institute of Scientific Research (IVIC), Caracas, Venezuela; and her PhD in ecology from the University of Georgia. Since 1989, she has worked as a professor and researcher at the Yale School of the Environment, as well as the Tropical Agriculture Research and Higher Education Center (CATIE). She has written 11 books and over 250 scientific articles about the ecology of tropical forests, agroforestry systems, native species reforestation, and forest landscape restoration.