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Landscape Ecology in Forest Management and Conservation

Challenges and Solutions for Global Change

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With 73 figures



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ISBN 978-7-04-029136-0
Higher Education Press, Beijing

ISBN 978-3-642-12753-3
Springer Heidelberg Dordrecht London New York

ISBN 978-3-642-12754-0 (eBook)

Library of Congress Control Number: 2010925386

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Cover design: Frido Steinen-Broo, EStudio Calamar, Spain

Printed on acid-free paper

Springer is part of Springer Science + Business Media (www.springer.com)

Foreword

Like many others, my first exposure to the science of landscape ecology was from the book entitled *Landscape Ecology* published by Richard Forman and Michel Godron in 1986. For me, this was a new and exciting way for looking at the world in which we live. It was obvious to me after reading this book that the science of landscape ecology had much to offer natural resources managers. But it is also important to recognize that a “landscape perspective” has been around for a long time in a variety of sources and in a variety of places. One example is a book published in 1962 by Paul B. Sears, an early ecologist in the United States, entitled *The Living Landscape*. In this book written for a general audience, Sears described with great elegance why a “landscape perspective” is relevant (page 162):

“Compared to the noblest work of human genius, the landscape about us offers endless variety of interest and challenge. It is more than something to look at, it is something to comprehend and interpret. We are inseparably a part of it, and it is equally a part of us. Our destinies are linked, and while Nature will assuredly have the final judgment, modern man has the power to determine whether it will be thumbs up or down.”

Aside from the gender bias that was common to that period, modern humanity indeed will be making important choices that will profoundly affect our children and many subsequent generations. Those choices should be predicated on the best available scientific knowledge. The current book edited by Li, Laforteza, and Chen is another valuable contribution to comprehending and interpreting forested landscapes. It represents the latest work resulting from the bi-annual meetings sponsored by the IUFRO Landscape Ecology Working Party (08.01.02). The strength of this book is in the fact that it reflects the experience and knowledge gained by scientists in 15 different countries. It also provides a rich source of international literature.

It would be naive, however, to think that all we need to cure our challenging environmental and human problems is to do good science. Humanity has to recognize what Sears stated so well in his book – “We are inseparably a part of it, and it is equally a part of us.” Until this linkage is clearly established

in the minds of humanity, our future is uncertain. Perusing the current book suggests that both the science of landscape ecology and its application have come a long way. This book is worthy of a place on our bookshelves and it should not be collecting dust. But we need more. We need to recognize that our destiny is inexplicitly linked to that of those landscapes in which we live, work, play, raise families, and, above all, depend on for our very existence.

Thomas R. Crow
Fort Collins, Colorado, USA

Preface

Landscape ecology, as an independent research field, has been developed rapidly over the past three decades, largely due to the effective applications of theories from other ecological research fields in a spatially explicit manner that endorses the development of new concepts and methodologies; advanced methods and technology related to the geographical information systems (GIS) that integrates, synthesizes, and manipulates geo-referenced information in an efficient way; fast-developed information technology (IT) that provides necessary computing power in implementing the research at large spatial and temporal scales; increasing availability of spatial data sets, especially from the aero photography and remote sensing (RS) techniques; and the practical needs from the industries, regulatory agencies, and communities and societies. Nowadays, the theories and concepts of landscape ecology are relevant not only for natural systems including climatic and environmental systems, but also for anthropogenic systems including social systems, economic systems, and coupled natural and human systems. The behaviour of resulting complex systems is hardly handled efficiently, except for the mathematical modeling approach. Thus, landscape models have become test fields for exploring the logical consequences of the interactions among different theories and concepts and this, in turn, reinforced the fast development of landscape ecology.

Forest landscape ecology has reached a relatively mature stage for applications to real forest management challenges and issues. Many published books on landscape ecology have been focusing on addressing theoretical, conceptual, and methodological concerns, which provide a solid foundation for its applications to assist forestry policy development and forest management decision-making. This book attempts to focus on more specific issues and/or challenges in forest management and land-based multi-purpose management in the changing global environment.

Forests across the world provide living environments, services, and life necessities for human, wildlife, and other organisms to sustain their generations. However, the increasing footprint from human activities on unmanaged forest landscapes has altered normal ecosystem processes under natural conditions. Consequently, forest ecosystem dynamics are much more complicated

to understand as a consequence of the interaction between human activities and natural processes. The impacts of global change have added more layers on top of coupled human-natural forest dynamics. The questions of how the global changes, especially climate change, could impact forest landscape dynamics and their management have become important challenges that forest managers, researchers, and professionals are facing. We consider these as both challenges and opportunities for landscape ecologists and practitioners to be able to address the question: how could landscape ecology research provide answers and solutions to forest management?

Forest management in a broad sense can have three main components: natural disturbance, habitat, and resource management, with each operation in any of the components can have an impact on the other components. The level of resource utilization is perhaps the only variable that humans can control to balance economic development and social, ecological, and conservation needs. Human's utilization of forest resources through harvest and land-use change has resulted in the reduced and fragmented forest lands and, in turn, the changes in wildlife habitat, biodiversity, productivity, old growth forests, environmental conservation, and other non-timber values including ecosystem goods and services. As a result, increasing attention has been paid to forest resource management with decreasing availability of forest lands and degrading quality of wood supplies. To contribute useful solutions to the forest management-related issues, landscape ecologists and researchers need to have a better understanding of the approaches, methods, procedures, and regulations involved in the forest management practice.

Understanding regional forest dynamics over space and time is crucial in forecasting the wood fibre supply. At the landscape scale, however, the critical issues are how the forest resource availability and habitat treatments could be influenced by natural and anthropogenic disturbances and their management. Natural disturbances such as fire, insect, disease, and wind can have profound impacts on forest dynamics as well as the quality of the resulting wood supply. Anthropogenic disturbances such as harvest can have an additive effect on forest landscapes and thus the sustainability and spatial distribution of forest resources. The mechanisms and processes of these disturbances need to be well understood for making informed management decisions.

Our expectation through this volume is to provide updated information on the approaches, procedures, and methods in practical forest management, which were different from those occurring decades ago. Research progresses in the three components of forest management and the development of decision support tools/systems driven by the spatially explicit landscape models toward solving the challenging issues in forest management.

This book consists of four parts: **Part 1** includes three chapters on landscape ecology and forest management, aiming at providing a conceptual framework and general background of contemporary forest management practices and procedures, challenges, and the research needs in a changing globe from

a forestry and forest science perspective and a brief summary of what could be contributed from landscape ecology research toward solutions in forest management. **Part 2** is composed of five chapters on modeling disturbance and succession in forest landscapes, with a focus on the management of natural disturbances, especially forest fire and related research topics, through spatially explicit model development and applications. **Part 3** includes four chapters on emerging approaches in forest landscape conservation, which focus on the management and conservation of wildlife habitat and biodiversity and discuss how the zoning process can be improved through developing a forest network system as well as the forest landscape fragmentation-related issues. **Part 4** contains five chapters on practicing sustainable forest landscape management, which focus on the management of forest resources and related issues including applications of landscape and habitat suitability models, the effect of abandonment, the loss of biodiversity in South America, and decision support technology for achieving sustainable forest management.

The book is a collection of knowledge and experience from 15 different countries and provides complementary information to existing international literature in this field in terms of forest management planning and problem-solving on large-scale issues from a long-term perspective. In addition, this book is designed to serve as a reference book for providing materials for higher education purposes, in that more and more universities are offering landscape ecology-related courses through their undergraduate and graduate programs in natural resources, agricultural and rangeland, forestry, environmental sciences, etc.

The editors are happy to see a new trend and a number of senior scientists encouraged their students and technicians who bravely took the responsibility of first author and/or corresponding author. This is a powerful way of training highly qualified personnel for the future study and this will contribute to the rapid promotion of the IUFRO Landscape Ecology Working Group.

This book is the third publication in a series of contributions from the activities of the IUFRO Landscape Ecology Working Group (08.01.02). Most of the chapters of this book are authored by participants of the 2008 IUFRO Landscape Ecology Bi-Annual Conference held in Chengdu, China, hosted by the Chinese Academy of Forestry (CAF), on September 16–22, 2008, including some other interested experts who participated in this conference. The conference was the biggest in number of participants and countries in the history for this Working Group. The success of the conference largely relied on the enthusiastic participation and professional contribution as well as support from many organizations, including the USDA Forest Service, the NASA Land-Cover/Land-Use Change Program (LCLUC), the Institute of Applied Ecology of the Chinese Academy of Sciences, Fudan University, the Northern Global Change Program of USDA Forest Service, the University of Toledo, the CSIS of Michigan State University, the Higher Education Press, the *Journal of Plant Ecology*, the IUFRO Landscape Ecology Working Group, the CAF,

the IUFRO Urban Forestry Working Group, the International Association of Landscape Ecology (IALE), the Sino-Ecologists Association Overseas (Sino-Eco), and the Sichuan Academy of Forestry (the local host). The success of this conference also depended on the strong logistic support provided by the ChuangWei Hong Company and the volunteers (Bixia Chen, Jessica Schaefer, Fei He, and others). We thank people of the Higher Education Press and Springer for their consistent support in considering this book.

We also appreciate very much the valuable and timely reviews from Devendra Amatya, João Azevedo, Huiquan Bi, Jan Bogaert, Kimberley Brososke, Enrico Caprio, Mauro Centritto, Reinhart Ceulemar, Liding Chen, Robert Corry, Mark Ducey, Almo Farina, Alberto Gallardo, Eric Gustafson, Shongming Huang, Hong Jiang, Ranjeet John, Pekka Kauppi, Bob Keane, Habin Li, Zhenqing Li, Changhui Peng, Ajith Perara, Soung-R Ryu, Santiago Saura, Sari Saunders, Rob Scheller, Conghe Song, Henrich Spiecker, Ge Sun, R Talbot Trotter III, Chuankuan Wang, Mingliang Wang, Xiaohua Wei, Jian Yang, and Pat Zoner. Finally, this publication would not be available without the tireless drive and support of Dr. Bingxiang Li of the HEP.

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