

Land Restoration to Combat Desertification

Innovative Approaches, Quality Control and
Project Evaluation

Edited by
Susana Bautista
James Aronson
V. Ramón Vallejo



© Fundación Centro de Estudios Ambientales del Mediterráneo – CEAM 2009

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, duplicating or otherwise, without the prior permission of the copyright owner. Contact Fundación CEAM for all permission requests.

ISBN: 978-84-921259-5-1

DL: V-4002-2009

Published by

Fundación Centro de Estudios Ambientales del Mediterráneo – CEAM

Charles R. Darwin 14. Parque Tecnológico

46980 Paterna (Valencia), Spain

Tel: +34 96 131 82 27; Fax: +34 96 131 81 90

E-mail: fundacion@ceam.es

<http://www.ceam.es>

This book was conceived in the context of the Advanced Study Course on *Land Restoration to Combat Desertification: Innovative Approaches, Quality Control and Project Evaluation*, organized by IAMZ (CIHEAM) in Zaragoza, 19-25 September 2005, in the framework of the European Commission project REACTION (DG Research, Fifth Framework Programme, Energy, Environment and Sustainable Development Programme, reference EVK2-CT-2002-80025). This edition has been co-funded by the Generalitat Valenciana and BANCAJA.

Printed in Spain by
LAIMPRESA CG

List of Contributors	6
Preface	9
I. Introduction	11
1. Problems and perspectives of dryland restoration	13
<i>V. Ramón Vallejo</i>	
II. The restoration process	23
2. Criteria for recognizing, organizing, and planning ecological restoration	25
<i>Andre Clewell, James Aronson, and James Blignaut</i>	
3. Economic, social and cultural factors affecting landscape restoration	35
<i>David Lamb</i>	
4. Evaluation of forest restoration projects	47
<i>Susana Bautista and José Antonio Alloza</i>	
5. Monitoring guidelines for the implementation of forest restoration projects in Mediterranean regions	73
<i>Rafael M. Navarro, J. Ramón Guzmán, Renata Herrera, Pedro A. Lara, Manuel Torres, Carlos Ceacero, Antonio del Campo, and Susana Bautista</i>	
III. Innovative approaches in forest restoration	87
6. Genetic quality of forest reproductive materials in land restoration programmes	89
<i>Ricardo Alía, Nuria Alba, Maria Regina Chambel, Diana Barba, and Salustiano Iglesias</i>	
7. Assessing morphological and physiological plant quality for Mediterranean woodland restoration projects	103
<i>Pedro Villar-Salvador, Jaime Puértolas, and Juan L. Peñuelas</i>	
8. Innovations in semiarid restoration. The case of <i>Stipa tenacissima</i> L. steppes	121
<i>Jordi Cortina, Fernando T. Maestre, and David A. Ramírez</i>	
9. Runoff and erosion from wildfires and roads: effects and mitigation	145
<i>Lee MacDonald and Isaac J. Larsen</i>	

List of Contributors

Nuria Alba
Departamento de Sistemas y Recursos
Forestales
Centro de Investigación Forestal-INIA
Crta. Coruña km 7.5
28040 Madrid, Spain

Ricardo Alía
Departamento de Sistemas y Recursos
Forestales
Centro de Investigación Forestal-INIA
Crta. Coruña km 7.5
28040 Madrid, Spain

José Antonio Alloza
Fundación CEAM
Charles Darwin 14, Parque Tecnológico.
46980 Paterna (Valencia), Spain

James Aronson
Restoration Ecology Group
CEFE/CNRS-UMR 5175
1919, Route de Mende,
34293 Montpellier, France,
and
RNC Alliance
Missouri Botanical Garden
St. Louis, USA

Diana Barba
Departamento de Sistemas y Recursos
Forestales
Centro de Investigación Forestal-INIA
Crta. Coruña km 7.5
28040 Madrid, Spain

Susana Bautista
Departamento de Ecología
Universidad de Alicante
Apdo. 99
03080 Alicante, Spain

James Blignaut
Department of Economics
University of Pretoria
Lynnwood Road
Pretoria 0002, South Africa

Carlos Ceacero Ruiz
EGMASA
Av. Johan Gutemberg s/n
41092 Sevilla, Spain

Maria Regina Chambel
Departamento de Sistemas y Recursos
Forestales
Centro de Investigación Forestal-INIA
Crta. Coruña km 7.5
28040 Madrid, Spain

Andre Clewel
RNC Alliance
5974 Willows Bridge Loop
Ellenton, Florida, 34222, USA

Jordi Cortina
Departamento de Ecología
Universidad de Alicante
Apdo. 99
03080 Alicante, Spain

Antonio del Campo García
Departamento de Ingeniería Hidráulica y
Medio Ambiente
Universidad Politécnica de Valencia
Camí de Vera s/n
46022 Valencia, Spain

José Ramón Guzmán Álvarez
Departamento de Ingeniería Forestal
ETSIAM. Universidad de Córdoba
Av. Menéndez Pidal s/n
14080 Córdoba, Spain

Renata Herrera
Departamento de Ingeniería Forestal
ETSIAM. Universidad de Córdoba
Av. Menéndez Pidal s/n
14080 Córdoba, Spain

Salustiano Iglesias
Servicio de Material Genético
D. G. Medio Natural y Política Forestal
Ministerio de Medio Ambiente, Medio Rural
y Marino
Rios Rosas 24
28003 Madrid, Spain

David Lamb
School of Integrative Biology
University of Queensland.
Brisbane, Queensland 4072, Australia

Pedro A. Lara Almuedo
EGMASA
Av. Johan Gutemberg s/n
41092 Sevilla, Spain

Isaac J. Larsen
Department of Forest, Rangeland, and
Watershed Stewardship
Colorado State University
Fort Collins, CO, USA 80523-1472

Lee H. Macdonald
Department of Forest, Rangeland, and
Watershed Stewardship
Colorado State University
Fort Collins, CO, USA 80523-1472

Fernando T. Maestre
Área de Biodiversidad y Conservación
Universidad Rey Juan Carlos
Tulipán s/n.
28933 Móstoles (Madrid), Spain

Rafael M^a Navarro Cerrillo
Departamento de Ingeniería Forestal
ETSIAM. Universidad de Córdoba
Av. Menéndez Pidal s/n
14080 Córdoba, Spain

Juan L. Peñuelas
Centro Nacional de Mejora Forestal “El
Serranillo”
Dirección General para la Biodiversidad
Ministerio de Medio Ambiente, Medio Rural
y Marino
Apdo. 249
19004 Guadalajara, Spain

Jaime Puértolas
Fundación CEAM
Charles Darwin 14, Parque Tecnológico.
46980 Paterna (Valencia), Spain

David Ramírez
Departamento de Ciencias Ambientales
Universidad de Castilla-La Mancha
Avda. Carlos III s/n
45071 Toledo, Spain

Manuel Torres Graciano
EGMASA
Av. Johan Gutemberg s/n
41092 Sevilla, Spain

V. Ramón Vallejo
Fundación CEAM
Charles Darwin 14, Parque Tecnológico.
46980 Paterna (Valencia), Spain

Pedro Villar-Salvador
Departamento de Ecología
Universidad de Alcalá
28871 Alcalá de Henares (Madrid), Spain

Preface

Many drylands in the world suffer problems of land degradation and desertification derived from human activities and exacerbated by drought. Too often these degradation processes have been endured by the ecosystems for a long time, and, according to forecasts of climate change, are likely to worsen in the future. Ecological restoration combined with adaptive management can be effective tools in response to this environmental and socioeconomic problem.

Reforestation and afforestation are restoration actions traditionally used to recover degraded lands for production and to alleviate on-going degradation processes. In some cases barren land has yielded magnificent forests, and in other cases the impacts are less clear. Despite the long-standing experience among scientists and land managers in reforesting degraded lands worldwide, in general, assessments of the results of land restoration projects are limited either in terms of data or breadth of perspective, and therefore little of real use can be drawn from this work. The lack of available scientific and technical information on restoration actions hampers the dissemination of technology within and among countries and regions, and the sharing and more comprehensive application of the best technology and approaches available. The need for more systematic and comparable evaluation of the results of restoration and management actions and more effective knowledge exchange and dissemination is widely acknowledged. The information needed includes biological, ecological and socio-economic aspects.

Recently, a number of different research and development projects funded by the European Commission have promoted the development of innovations in dryland restoration and reforestation. To improve scientific and technical communication on land restoration, and to capitalise on recent scientific advances in this area, the REACTION project (Restoration Actions to Combat Desertification in the Northern Mediterranean, www.ceam.es/reaction) was launched under the Fifth Research, Technology and Development Framework Programme of the European Commission, in the key action area "Climate Change and Ecosystems". The project has led to the establishment of a Northern

Mediterranean network, information system, and database on land restoration to fight desertification, and the development and testing of an indicator-based protocol to evaluate the results of forest restoration projects in the Mediterranean. The present book summarizes the main achievements of the REACTION programme and provides a series of restoration guidelines developed in the light of past and present innovative approaches.

The objective of this book is to present the latest scientific and technical advances in land restoration with the purpose of combating desertification in arid, semi-arid and dry-subhumid regions, with emphasis on reforestation actions in the Mediterranean region. This includes the identification of the innovative aspects of the land restoration process, from project planning to execution and the monitoring of results, as well as restoration technology, from plant production in the nursery to planting or seeding. Specific attention is paid to the discussion and development of criteria and procedures for quality control of all processes forming part of forest restoration projects, from seed collection to monitoring protocols. As a further outcome of REACTION, we also present a methodology for long term forest restoration assessment on the basis of updated, practical information of particular interest to practitioners in dryland restoration, e.g., in the framework of the United Nations Convention to Combat Desertification, and the respective National and Regional Action Plans. We do not attempt to address all possible, and especially theoretical aspects of ecological restoration, but only those we consider at the cutting edge of practical land restoration. We hope it will help.

Susana Bautista, James Aronson and V. Ramón Vallejo