RESEARCH FOR RESTORING TROPICAL FOREST ECOSYSTEMS: A PRACTICAL GUIDE

COMPILED BY
STEPHENV ELLIOTT,
DAVID BLAKESLEY AND
SUUTTHATHORN CHAIRUANGSRI

ARTWORK BY SURAT PLUKAM

SPONSORED BY THE UK’S DARWIN INITIATIVE
FIRST EDITION 2008
“Research for Restoring Tropical Forest Ecosystems: A Practical Guide” has no copyright. It has been designed to be easily reproduced and freely available to all those interested in carrying out research to enable more efficient restoration of tropical forest ecosystems. All we ask is that proper acknowledgement is made as to the origin of the material. **Please cite as:**

**Forest Restoration Research Unit**, 2008. Research for Restoring Tropical Forest Ecosystems: A Practical Guide. Biology Department, Science Faculty, Chiang Mai University, Thailand.

This book is available in several languages To order additional copies of any language edition, please email the following:-

**English**
Dr. Stephen Elliott (for SE Asia)
stephen_elliott1@yahoo.com or
Dr. David Blakesley (for Europe)
david.blakesley@btinternet.com

**Thai**
Dr. Sutthathorn Chairuangsr
s.suwann@chiangmai.ac.th

**Lao**
Mr. Sounthone Ketphanh
sounthone53@yahoo.com

**Chinese**
Mr. He Jun
h.jun@cgiar.org

**Khmer**
Mr. Nup Sothea
nupsothea67@yahoo.com
# CONTENTS

## Acknowledgements

- V

## Preface

- VI

### Part 1  Forest Restoration - Fundamental Tools and Concepts

- 1

  - Section 1  What is Forest Restoration?  
  - 3
  - Section 2  Forest Degradation and Restoration Strategy  
  - 7
  - Section 3  Forest Landscape Restoration  
  - 20

### Part 2  Establishing a Forest Restoration Research Unit (FORRU)

- 21

  - Section 1  Organization and Human Resources  
  - 23
  - Section 2  Working at All Levels  
  - 26
  - Section 3  Facilities Required  
  - 30
  - Section 4  Funding  
  - 35

### Part 3  Propagating Trees for Forest Restoration

- 37

  - Section 1  Selecting and Identifying Candidate Framework Tree Species  
  - 39
  - Section 2  Phenology  
  - 43
  - Section 3  Seed Collection  
  - 49
  - Section 4  Germination Tests  
  - 51
  - Section 5  Seed Storage  
  - 56
  - Section 6  Tree Performance Experiments  
  - 58
  - Section 7  Experiments with Wildlings  
  - 66
  - Section 8  Production Schedules  
  - 69

### Part 4  Field Experiments

- 71

  - Section 1  The Field Trial Plot System (FTPS)  
  - 73
  - Section 2  Location, Establishment and Design of a FTPS  
  - 75
  - Section 3  Data Collection  
  - 81
  - Section 4  Data Analysis and Interpretation  
  - 84
  - Section 5  Direct Seeding  
  - 87

### Part 5  Monitoring Forest Recovery

- 91

  - Section 1  Assessing the Production of Wildlife Resources  
  - 94
  - Section 2  Wildlife Monitoring  
  - 95
  - Section 3  Monitoring Forest Regeneration  
  - 101

### Part 6  From Research to Restoration

- 105

  - Section 1  Managing Information  
  - 107
  - Section 2  Selecting Species  
  - 113
  - Section 3  Informing Stakeholders  
  - 118
  - Section 4  Planning a Communications Strategy  
  - 121
  - Section 5  Implementing Forest Restoration  
  - 123

---

RESEARCH FOR RESTORING TROPICAL FOREST ECOSYSTEMS  

III
APPENDICES

Section 1  Randomized Complete Block Design  127
Section 2  Analysis of Variance  129
Section 3  Paired T-tests  131
Glossary  132
References Cited and Further Reading  137
Index  141

HOW TO CONTACT FORRU-CMU  144
ACKNOWLEDGEMENTS

This manual presents concepts and research techniques for restoring forest ecosystems, developed by the Forest Restoration Research Unit of the Biology Department of Chiang Mai University’s Science Faculty (FORRU-CMU) since 1994. It is one of the outputs of the project “Facilitating Forest Restoration for Biodiversity Recovery in Indochina”, sponsored by the UK’s Darwin Initiative. We thank the Darwin Initiative for funding production costs.

FORRU-CMU was co-founded by Assoc. Prof. Dr. Vilaiwan Anusarnsunthorn, Dr. Stephen Elliott and Dr. David Blakesley in 1994, in association with the Headquarters staff of Doi Suthep-Pui National Park, where the unit’s research nursery was built. We are grateful to all the park chiefs who have provided logistical support for the unit over the years, including Mr. Prawat Wohandee, Mr. Amporn Panmongkol, Mr. Wirat Rojanajinda, Mr. Suchai Omapiyan, Mr. Paiboon Sawatmelanon, Mr. Prasert Saentaam, Mr. Anan Sorngai and Mr. Surachai Tuamsomboon.

The information in this manual is the result of the dedicated work of FORRU-CMU’s research team, including Mr. Cherd sak Kuaraksa, Dr. Greuk Pakkad, Ms. Paniitnard Tunjai, Ms. Thonglaw Seethong and Ms. Somkit Kungotha. FORRU’s Darwin Education Team, also contributed significantly; Mr. Kunakorn Boonsai, Ms. Sudarat Zangkum and Ms Tiderach Toktang. We thank Ms Jenny Schabel for help with graphics and layout and for contributing to Part 6, David Moore for final editing, and Ms. Rungtiwa Bunyayod for laying out the Thai edition.

The framework species method of forest restoration was first conceived in Queensland Australia and we are indebted to Mr. Nigel Tucker and Ms. Tania Murphy for introducing FORRU-CMU staff to the concept at Lake Eacham National Park, Queensland, in 1997. Collaboration with the villagers of Ban Mae Sa Mai has been essential for the success of the unit, particularly Mr. Naeng Thanonworakun and his family, who take care of the village tree nursery and co-ordinate our work with the community.

FORRU-CMU was founded with sponsorship from Riche Monde (Bangkok) Ltd. and has subsequently been supported by Chiang Mai University, Thailand’s Biodiversity Research and Training Program, the U.K.’s Eden Project and Darwin Initiative, Shell International Renewables, Guinness PLC, World Wildlife Fund (Thailand Program), King Power and the Plant a Tree Today Foundation. We thank them all.

The text of this book was compiled by Dr. Stephen Elliott and Dr. David Blakesley. We thank Dr. George Gale for helpful comments on the manuscript. The Thai edition was adapted and translated by Dr. Sutthathorn Chairuangsri. All artwork is by Mr. Surat Plukam and photographs were taken by FORRU-CMU staff. The opinions expressed in this book are those of the compilers and not necessarily those of the sponsors or reviewers. The compilers thank anyone, not already mentioned, who has contributed towards FORRU-CMU’s work or the production of this book. Finally, we are grateful to the Biology Department, Science Faculty, Chiang Mai University and Wildlife Landscapes for institutional support of FORRU and East Malling Research for acting as collaborative U.K. partner for Darwin Initiative projects and former institutional support of Dr. David Blakesley’s contribution to FORRU-CMU’s work.
PREFACE

Around the world, many attempts to “re-create natural” forest ecosystems on deforested land have failed. This has often been due to poorly developed techniques, as well as poor management and failure to engage local people. However, this need not be the case. This book (together with its companion volume ‘How to Plant a Forest’ (FORRU, 2006)) sets out to show how successful and innovative forest restoration strategies can be devised to suit the various ecological and socio-economic conditions represented across SE Asia.

In 2002, Chiang Mai University’s Forest Restoration Research Unit (FORRU-CMU), and its UK partner, East Malling Research (EMR), were awarded a grant by the UK’s Darwin Initiative for a 3-year project entitled “Education and training for restoring tropical forest biodiversity”. The manual, ‘How to Plant a Forest: the Principles and Practice of Restoring Tropical Forest Ecosystems’ was a major output of that project. It made available, to all those interested in restoring forest ecosystems in northern Thailand, tried and tested techniques, based on a decade of research by FORRU-CMU. Using an easily accessible format, the manual showed how the framework species concept of forest restoration has been successfully adapted to re-establish natural forest ecosystems in seasonally dry tropical areas and presented all the practical information necessary to implement a forest restoration project.

Although the manual was distributed, as an example, throughout SE Asia and translated into six languages (Thai, Chinese, Lao, Khmer, Vietnamese and English), the information presented in it was mostly applicable to the seasonally dry tropical forests of northern Thailand. Many of the techniques and the framework tree species recommended in it may not be suitable for the various ecological conditions and socio-economic circumstances that exist in other parts of tropical SE Asia.

The current title “Research for Restoring Tropical Forest Ecosystems: A Practical Guide” takes the next logical step. It presents the generic concepts and research protocols that were used to develop successful forest restoration in N. Thailand. By adapting such concepts and protocols locally to indigenous forest ecosystems and their tree floras, it should be possible to develop successful methods to restore forest ecosystems anywhere in tropical SE Asia.

This is a book for researchers. It is aimed at helping anyone involved in setting up and running a Forest Restoration Research Unit to devise a suitable framework species approach to the restoration of forest ecosystems for biodiversity conservation and/or environmental protection. It is one of the main outputs from another UK Darwin Initiative project entitled “Facilitating Forest Restoration for Biodiversity Recovery in Indochina” (2005-2008), carried out jointly by EMR, Wildlife Landscapes and FORRU-CMU and in collaboration with the International Centre for Research on Agro-forestry, China, the Forest and Wildlife Science Research Institute, Cambodia and the Forestry Research Centre, Laos.

Dr. Stephen Elliott,
Dr. David Blakesley &
Dr. Sutthathorn Chairuengsri