

TROPICAL
FORESTRY



Reiner Finkeldey
Hans Heinrich Hattemer

Tropical Forest Genetics

 Springer

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Tropical Forest Genetics

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Preface

This book is intended to provide information on fundamental genetic processes in tropical forests. It is based on lecture notes by the authors prepared for post-graduate students, mainly from tropical countries, of the M.Sc. course “Tropical and International Forestry” at the Faculty of Forest Sciences and Forest Ecology, Georg August University Göttingen, Germany. The intended readership is students, researchers and practitioners interested in the genetic variation of species, in particular forest trees, living in complex forest ecosystems in the tropics. Particular emphasis is placed on the human impact on forest genetic resources in the tropics.

Readers should be familiar with basics of classical and molecular genetics such as the structure and function of DNA (double-helix structure, replication), polypeptide synthesis (transcription and translation), and the transmission of genetic information during sexual reproduction (“Mendel’s rules”). This knowledge is easily available from recently published genetics textbooks; we recommend the book by Griffiths et al. (2000).

The development of biochemical and molecular marker techniques and their application to species of tropical forests have greatly improved our knowledge of genetic variation patterns of “wild” plants in the tropics during the last two decades. Many examples in this book are based on gene marker techniques. We discuss the results of selected molecular studies and their implications for the development of sustainable management strategies for forest genetic resources. However, we refrain from providing details on laboratory techniques and statistical data analyses. Readers should consult the cited references or the book by Weising et al. (2005) if they require additional information in this regard. No advanced knowledge concerning modern molecular or statistical methods for the analysis of genetic variation patterns is necessary to follow the argumentation of this book.

Comprehensive data on DNA sequences are becoming available for more and more plants, including forest trees. The first project aimed at sequencing the full genome of a forest tree (*Populus trichocarpa*) has recently been completed (Brunner et al. 2004). However, only very few genomic data are currently

available for tropical forest trees; tropical forest genetics is still in a “pre-genomic era.” Thus, the focus of this book is on population genetics processes in natural and managed tropical forests rather than on genomics and related, newly emerging fields of research in forest genetics.

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. . . the significance of forest genetics lies not only in squeezing extra gain out of marginal investments, but more importantly in understanding the genetics of forests, in appreciating what forest ecosystems are and how they operate, and in better stewards of forest resources (Namkoong 1989).

The importance of forest ecosystems for environmental protection, global biodiversity, and human welfare can hardly be overestimated. Genetic resources are widely recognized as the basis of biodiversity and the main components of ecosystems. Conservation and utilization of genetic resources are crucial aspects of sustainable forest management practices. However, our current understanding of forest genetic resources is poor at best. Genetic variation patterns have been studied for a small fraction of forest trees only. Evolutionary processes resulting in variation within species are difficult to study for long-living organisms such as forest trees, and human impact on forest genetic resources is often subtle.

Thus, it is hardly surprising that misconceptions about forest genetic resources and implications of human impact on genetic resources are commonplace. This holds specifically true for tropical forests, which deserve particular attention for the following reasons. First, tropical forests are centers of biological diversity at least at the level of species diversity. Second, human impact on forest ecosystems is particularly severe in the tropics. Alterations of land use, notably deforestation, endanger forest genetic resources in most tropical countries. Common silvicultural practices such as selective cutting systems based on target diameters threaten genetic resources in managed forests. On the other hand, many tropical countries have launched ambitious reforestation and afforestation programs. The choice of reproductive material used for plantation establishment is a matter of vital importance for the success of reforestation programs. Utilization of genetic resources (tree improvement) plays an important role in this context.

This book is aimed at familiarizing readers with the fundamental principles related to genetic resources in tropical forests. We will concentrate our discussion on forest trees since trees are by definition the main structural and functional