Hai Ren *Editor*

Conservation and Reintroduction of Rare and Endangered Plants in China

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Preface

In the face of unprecedented biodiversity losses and global change, effective approaches for the conservation of rare and endangered plant species are urgently required. The major approaches to integrative plant conservation include in situ conservation, ex situ conservation, and reintroduction. Reintroduction may be especially effective at protecting and rescuing rare and endangered plants.

China has protected about 65% of the vascular plant communities through in situ conservation in natural reserves and national park systems and has preserved about 60% of the plant species through ex situ conservation in botanical gardens and other ex situ conservation facilities. However, we know less about reintroduction in China. Throughout the book, we and our invited authors explore to what extent information about reintroduction of plants is currently available in China.

This book is composed of two parts. Part I introduces the plant diversity and its conservation in China, and Part II displays some cases of reintroduction of rare and endangered plants in China. The majority of the chapters in the book are devoted to the case studies of reintroduction.

Books such as this one become a reality only with the support and involvement of many people. The editors are indebted to the team of enthusiastic authors, all famous experts in the fields in China, who have made available experience. The editors divide their work as follows: Prof. Hai Ren designed the contents and organized the manuscripts. Prof. Hongfang Lu edited Chaps. 1–4, Dr. Hongxiao Liu edited Chaps. 5–20, Director Ju Zhou co-organized the manuscripts and co-conceived the contents, Prof. Yan Zeng edited tables, photos, and figures. Thanks to Prof. Elizabeth Platt Hamblin for editing English. We thank the anonymous reviewers for their constructive comments. We are very grateful to Dr. Xin Zhu and Beracah John Martyn for their careful fine-tuning of the editorial work at press.

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that this small book will be of value in stemming the tide of plant diversity loss and unsustainable development in China and even in the world. This book is dedicated to Convention on Biological Diversity-COP 15, which will be held in 2021 in Kunming, China.

Guangzhou, China Hai Ren
November 12, 2019

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Prof. Hongfang Lu, Dr. Hongxiao Liu, Director Ju Zhou, and Prof. Yan Zeng are Associate Editor-in-Chief.

Prof. Hongfang Lu edited Chaps. 1–4, Dr. Hongxiao Liu edited Chaps. 5–20, Director Ju Zhou co-organized the manuscripts and co-conceived the contents, Prof. Yan Zeng edited tables, photos, and figures.

Contents

Conservation Translocations of *Manglietia longipedunculata*, a Critically Endangered Tree in South China

Hai Ren, Hongxiao Liu, Qianmei Zhang, Yan Zeng, Ju Zhou, Wenhui Zhu, and Xiaodong Cui

Abstract There are only 11 individuals of *Manglietia longipedunculata* in the wild. The species is with low reproductive success and cannot produce fruit under natural conditions. Augmentation and translocation of the species were conducted by emerged and grafted seedlings in 2009. More than 64% of seedlings of both augmentation and translocation grew well after 5 years' transplantation in both sites. Grafted seedlings had better growth rate and ecophysiological performance and reached flowering age earlier than the emerged ones. Therefore, grafted seedlings have superior adaptability to abiotic stress. Grafting may be a useful method for in situ augmentation and conservation translocations of this species and probably is also applicable to rare species having semblable reproductive disorders.

Keywords Grafting seedling · Cutting seedling · Augmentation · Reproductive obstacles

1 Introduction

Manglietia longipedunculata is an evergreen, canopy tree (Fig. 1). Currently this species has 11 individuals which all grow in evergreen broadleaf forest at the Nankunshan Nature Reserve, Longmen County, Guangdong Province, South China (Ren et al. 2016). *M. longipedunculata* is documented on the Red List of

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Fig. 1 An individual of *Manglietia longipedunculata*

Magnoliaceae (Cicuzza et al. 2007). *M. longipedunculata* has large flowers, red fruit, and beautiful foliage and thus is a favorable decorative plant (Fig. 2). In addition, it can produce high-quality timber of high economic value (Fig. 1). The low reproductive success of *M. longipedunculata* can be attributed to protogyny, short period of stigma receptivity, and insufficient insect pollinators (Xie et al. 2011). It cannot produce fruit under natural conditions. Unfavorable climate and increase in temperature may contribute to the lack of pollinators to some extent. Currently, seeds can only be obtained via human aid pollination. However, 50% of the seeds are not viable (Fang et al. 2006).

2 Description of Reintroduction

2.1 Feasibility

Before our conservation effort, research was conducted on *M. longipedunculata*. Zeng and Law (2004) and Xie et al. (2011) had conducted a thorough survey in the Nankunshan Nature Reserve during 2007–2008. Xie et al. (2011) studied the causes

Fig. 2 The habitat of *Manglietia longipedunculata*

of the low reproductive success of this species, while Fang et al. (2006) studied the seed propagation of this family. Based on previous knowledge, we surveyed for existing wild *M. longipedunculata* during March 2010 and June 2013 and measured height and diameter of each located individual. Two mature resprouted branches from one *M. longipedunculata* stump at Nankunshan were manually pollinated in June 2008. Seeds were collected in September 2008, which provided material for conservation translocation.

2.2 Implementation

We implemented an augmentation at Nankunshan Nature Reserve and a conservation introduction at Tianxin Nature Reserve. The seeds from hand-pollination were planted instantly in the magnolia garden of the South China Botanical Garden.

About 1400 emerged seedlings grew successfully. In 2008, we grafted 200 *M. longipedunculata* scions (2–3 cm each) to 200 rootstocks of 1-year-old *Manglietia moto*. In March 2009, we randomly chose 145 emerged and 145 grafted healthy individuals of similar size, among which 100 seedings of each type were planted at Nankunshan. The other 45 individuals of each type were planted at Tianxin. At both Nankunshan and Tianxin site, a 1-ha experimental field was parted into three blocks. Each block has two 50 × 30 m plots. At Nankunshan site, we planted 33–34 emerged or grafted seedings in each plot. At Tianxin site, 15 seedlings of each type were planted in each plot. Seedlings were irrigated three times on the first, third, and seventh day after transplantation. All trees and shrubs were removed from all plots before transplantation to avoid competition. The plots were not fenced, fertilized, or mulched. No management measures were taken.

2.3 Post-planting Monitoring

In the augmentation and conservation introduction practice, we monitored the community ecology and ecophysiological indicators (Fig. 3). Plant height and diameter were measured instantly after transplantation and were monitored once a year for 5 years. If a transplant was dead, we examined possible causes including insect defoliation, fungal decay, nutrient deficiency, drought, or radiation stress, according to its appearance. We measured light-use and water-use efficiencies of these plants at Nankunshan on 3 and 4 June 2013 and at Tianxin on 12 and 13 June 2013. We also measured photosynthetic and physiological indicators including actual photochemical efficiency, photochemical fluorescence quenches, etc. (Ren et al. 2016). Environmental factors were collected at the same time. The seedlings become relatively stable after 1 year from transplantation. Five years' survive rate is over 64% at both sites and for both grafted and emerged seedlings. But grafted seedlings had better growth rate and ecophysiological performance than emerged ones. Grafted seedlings reach flower period earlier than the emerged seedlings. Therefore, grafted technique can be more adaptive to abiotic stress.

3 Problems and Recommendations

- Grafting technique could be useful in in situ augmentation and conservation translocations of *M. longipedunculata*. It is likely applicable to other rare species having alike reproductive disorders.
- A package conservation plan for this species was required including patrolling to prevent plant removal, establishment of an ex situ grafted living collection to keep genetic diversity, enhancing *M. longipedunculata* reproduction for commercial use, and conducting augmentation and translocation.

Fig. 3 Monitoring the eco-biological characteristics of *Manglietia longipedunculata*

- We suggest that hand-pollination can facilitate fruit set and thus aid the population spread both in situ and ex situ. More introductions should be conducted to augment existing populations.
- Tianxin may be more proper habitat for *M. longipedunculata* than Nankunshan, considering possible future temperature rise. This research implied that conservation introduction may be a feasible approach to sustain the species in the wild.

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