

Hai Ren *Editor*

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# 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.

The financial support from Chinese Academy of Sciences and Ministry of ecological environment (No. 8-3-7-20-10) is gratefully acknowledged. We hope

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  
November 12, 2019

Hai Ren

# Acknowledgements

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.

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# Reintroduction of *Camellia changii* Ye (Theaceae), a Critically Endangered Plant Endemic to Southern China



Hai Ren, Hongxiao Liu, Qianmei Zhang, Yi Xu, Ju Zhou, and Yan Zeng

**Abstract** *Camellia changii* Ye is an evergreen tall shrub or small tree with an extremely narrow distribution. There are only 1039 individuals in the field. The community characteristics, genetic diversity, and reproductive barriers of *C. changii* were studied. An ex situ living collection was established, which contained the entire wild genetic diversity by grafting techniques. Grafted plants were used to conduct augmentation and conservation introduction at two sites. All transplants grew successfully after 2 years at the two sites. We concluded that the out-of-range conservation introduction of *C. changii* did not reduce reproductive success compared with augmentation.

**Keywords** Global change · Conservation introduction · Grafting plant · Augmentation · Genetic diversity · Reintroduction

## 1 Introduction

*Camellia changii* Ye is an evergreen tall shrub or small tree in South China. It is an insect-pollinated and self-incompatible species. It has 1039 individuals in the sole wild population. *C. changii* is endemic to an extremely narrow geographical scope. The species was documented by the conservation list of extremely small populations in China in 2012 (Ren et al. 2014). It is known among Chinese botanists as the “giant

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**Fig. 1** The *Camellia changii* Ye in flower season

panda of the plant kingdom” because of its rarity and charm (Fig. 1, Wang and Xie 2004). *C. changii* were located within Ehuangzhang Nature Reserve in Yangchun County, Yangjiang City, south-west Guangdong Province (Fig. 2, Wu 1998; Zhang 1999). This wild population suffers to not only natural threats, such as global climate change, but also human collection due to its high ornamental value (Ren et al. 2014). Other threats include development of local tourism and recreation within the nature reserve, construction of small dams, and smallholder farming and also its restricted range, limited recruitment, and potential inbreeding depression as a result of the small population size and low genetic diversity (Luo et al. 2007).

## 2 Description of Reintroduction

### 2.1 Feasibility

Before our conservation practices, researches were conducted for *C. changii* concerning its community characteristics, genetic diversity, and reproductive barriers (Luo et al. 2007, 2008, 2011). Building on previous knowledge, we examined all specimens of *C. changii* deposited in the herbaria of the South China Botanical Garden, Chinese Academy of Sciences, and Sun Yat-sen University (Ren et al. 2014). Both herbaria are major depositories for collections of plant material in Southern China. We then surveyed for *C. changii* in the Ehuangzhang Nature Reserve from January 2009 to January 2013.

**Fig. 2** The habitat of *Camellia changii* Ye



## 2.2 Implementation

From February 2013 to December 2014, we conducted experiment to compare the performance of two types of conservation translocation, i.e., augmentation and conservation introduction at two sites (Ehuangzhang and Tianxin, respectively; Ren et al. 2016). Attesting experiment, both the grafted and cutting plants survived and grew well, while the grafted plants performed a relatively higher survival rate and growth speed at both sites. Therefore, grafted plants were taken as materials. In March 2009, we grafted 300 *C. changii* scions (2–3 cm each) to 300 rootstocks of 1-year-old *Camellia gauchowensis*. Of the 300 grafted plants, more than 280 grew wells and began to bloom in 2012. In January 2013, we planted 45 grafted plants at both Ehuangzhang and Tianxin site. A 1 ha experimental field was set in each site. Three plots were partied in each experimental field. Each plot was future divided into a  $3 \times 3$  m grid systems and 15 grafted plants were planted. We irrigated the plants several times after transplanting. Since *C. changii* plants are sun-tolerant, we

removed all trees and shrubs from all plots before transplantation to avoid competition. Afterward no management measures were taken to these plants. The plots were not fenced, fertilized, nor mulched (Ren et al. 2016).

### 2.3 Post-planting Monitoring

The survival rate and height of each plant were measured every 6 months for 2 years from January 2013 to December 2014 (Fig. 3). Floral phenology, pollinator, and fruit and seed productions were observed and anthocyanin content of petals was analyzed. We recorded the flowers from each plant every week during 2013 and 2014. Flower visitors were observed at both sites during the peak flowering period for 12 days (3 days in May, July, September, and October, respectively) each year. In each plot, we harvested the petals of five flowers from individual *C. changii* and analyzed the anthocyanin content of these petals (Ren et al. 2016). All of the *C. changii* were successfully transplanted after 2 years at both sites. Detailed result can be found in Ren et al. (2016). We concluded that out-of-range conservation introduction of *C. changii* did not have a lower reproductive success than augmentation.



**Fig. 3** The transplanted seedling of *Camellia changii* Ye

### 3 Problems and Recommendations

- An integrative species conservation plan for the species that includes patrolling the Ehuangzhang Nature Reserve to prevent plant removal may be beneficial.
- Other potential strategies include establishing an ex situ living collection that contains the entire wild genetic diversity (accomplished by grafting of short cuttings from all wild individuals), facilitating propagation for commercial use, and implementing reintroduction to augment the wild population.
- *C. changii* should be categorized as Critically Endangered on the IUCN Red List.

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