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Hongwen HUANG

The Chinese Botanical Gardens

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Ecological Civilization-Building a Shared Future for All Life on Earth

KUNMING · CHINA

Ecological Civilization—Building a Shared Future for All Life on Earth

This book is dedicated to the 15th Meeting of the Conference
of the Parties to the *Convention on Biological Diversity*

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Chapter 2 A Brief Introduction of Botanical Gardens of China

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Chapter 3　Status Quo and Developmental Prospects of *The Chinese Botanical Gardens*

HUANG Hongwen　LIAO Jingping　ZHANG Zheng　ZHAO Tong

Preface

There are about 2,000 existing botanical gardens (arboreta) in the world, with about 100,000 species of higher plants collected and preserved. Of these species, about 15,000 are endangered plants. These gardens receive 200 million visitors annually, promoting the advancement of plant science and public knowledge services. Due to the lack of systematic review of the historical and current data of Chinese botanical gardens, the basic status of the number of botanical gardens, conservation capacity, and plant *ex situ* conservation are unclear, and the national strategy for *ex situ* conservation of plant diversity is difficult to clarify. After more than four years of questionnaire survey, literature research, and field visits, the team of *Ex Situ Cultivated Flora of China* in South China Botanical Gardens carried out a comprehensive survey of the national botanical gardens and their *ex situ* conservation, analyzed the development status and existing problems of the Chinese botanical gardens, and proposed relevant suggestions. They expected to promote the joint development of the national botanical gardens through the implementation of the "Construction and Evaluation of the National Standard System of Botanical Gardens" and the compilation and research of *Ex Situ Cultivated Flora of China*, and to play an active role in integrating the protection and utilization of plant resources.

Since the establishment of the Hong Kong Zoological and Botanical Gardens in Hong Kong by Westerners in 1871, the Chinese botanical gardens had experienced about 150 years. But before 1950, the botanical gardens and arboretums in China were mainly established by colonists, and secondly by the Chinese. The main purpose of the botanical gardens and arboretums established by the Chinese was to meet the needs of research of plant resources and teaching in China, and the period before 1950 was a difficult stage in the history of the construction of botanical gardens in China. Over the past hundred years, there are three stages in the large-scale construction of modern botanical gardens, namely the restoration and exploration stages from 1950 to 1964, the rapid development stage from 1980 to 1994, and the steady development stage since 1995. The main functions of the botanical garden change from the investigation of plant resources, introduction and domestication to the protection of rare and endangered plants and the protection of biodiversity. There are 161 botanical gardens and arboretums that cover the main climatic regions in China, such as the tropical humid regions, the subtropical regions, and temperate regions, but there is no botanical garden in the cold and temperate regions on the Qinghai-Xizang Plateau.

After the founding of the People's Republic of China, especially since 1980, the Chinese botanical gardens have made great progress in plant *ex situ* conservation and staff construction, and have become an important force in the international botanical gardens. At present, the total area of Chinese botanical gardens has reached 102,007.2 hm^2, of which the area of gardens for specific collections is 5,400 hm^2, and the area of natural vegetation is 76,171.7 hm^2. China has built *ex situ* conservation experimental facilities of a certain scale, of which the area of plant conservation or nursery is 1,014.9 hm^2, the area of micro-propagation facilities is 36,745 m^2, the area of seed banks or seed specimen banks with an area of 11,962 m^2, and the area of specimen arboreta is 30.4 hm^2. Chinese botanical gardens and arboreta have established a large-scale workforce. The

total number of employees is 11,227, including 2,876 scientific researchers, 2,937 landscaping and horticulture managers, 1,161 science popularization education personnel, more than 103 well-known botanical specialty experts, which have formed a certain influence in the field of international botanical gardens and plant *ex situ* conservation.

According to a sample survey of *ex situ* conservation plants in China, there are 396 families, 3,633 genera and 23,340 species. Among them, 288 families, 2,911 genera and 22,104 species are native plants, accounting for 91% of the family, 86% of the genera and 60% of the species in native higher plants, respectively. The living collections and cultivation in the Chinese botanical gardens and arboreta have formed the core and backbone of China plant *ex situ* conservation. About 40% of rare and endangered plants of the latest checklist of *China Plant Red Data Book* have been conserved *ex situ* in the Chinese botanical gardens. The Chinese botanical gardens and arboreta currently have 1,195 gardens of living collections. According to the preliminary analyses and statistics, 51 families with more than 100 species, 34 genera with more than 50 species, and 15,199 species of living plants have been collected and *ex situ* cultivated in these gardens, which have played a positive role in the conservation of native plants in China. Due to their institutional characteristics, the botanical gardens of Chinese Academy of Sciences (CAS) have long been engaged in the collection, research, discovery and utilization of specific genus and family, and some specialized plants. The botanical gardens of CAS have the characteristics of long history, rich accumulation, strong regional representation and strong systematic data accumulation, and play a significant leading role in the number of accessions, *ex situ* conservation species, nationally and locally endemic species, rare and endangered species. The 119 members of Chinese Union of Botanical Gardens have extensive coverage and regional representation. In the national botanical garden system, the top 50 botanical gardens in the number of *ex situ* conservation species, specialized living collection gardens, China and endemic species, and rare and endangered species have the botanical garden representativeness and the complete information of *ex situ* conservation, have an extensive representative of *ex situ* collection and play a central role in plant *ex situ* conservation in China.

China's huge resource platform for the introduction, *ex situ* cultivation and protection of plants at home and abroad in recent decades has played an important role in basic botanical studies, such as plant taxonomy, morphological anatomy, reproductive development, and genetic breeding. Based on living plant collection, the Chinese botanical gardens have made great progress in scientific research, and have played an extremely important role in the exploration and utilization of plant resources. The Chinese botanical gardens have become high-quality tourist scenic spots and important tourist destinations. A systematic service facility of public education and tourism has been established in order to facilitate and launch the public education courses for universities and middle and primary schools, and science popularization activities with unique features of botanical gardens. The number of tourists reached 160 million from 2012 to 2014, including 30 million young people, clearly suggests that the Chinese botanical gardens provided good social benefits.

However, the history of the Chinese modern botanical gardens is relatively short, and some problems exist in the botanical garden construction and management. For example, the Chinese botanical gardens lack the overall planning and deployment at the national level and the management norms of botanical garden construction. Pan park-based phenomenon exists in the management of botanical gardens. The collection of living plants and the management of *ex situ* conservation in the Chinese botanical gardens are insufficient. The management and information recording of living plants in the Chinese botanical gardens have not received sufficient attention. Scientific researches on the collection of living plants are deficient, and the applications of plant resources need to be strengthened. Public education and knowledge dissemination mostly stay at the

level of publicity, and it is urgent to construct and implement an educational curriculum system that is in line with international standards.

During the investigation and compilation of *The Chinese Botanical Gardens*, a large number of materials have been searched, sorted and summarized. Many colleagues in each botanical garden have participated in the collection and sorting of the data and the investigation of the botanical gardens. Some of them have been indicated in the book, but many contributors may still be omitted. Thanks for the supports from projects of Construction and Evaluation of National System of Botanical Garden Standards (KFJ-1 W-NO1 and KFJ-3 W-NO1-2), China-Compilation of *Ex Situ Cultivated Flora of Botanical Gardens* (NO. 2015FY210100), Key Laboratory of Plant Resource Conservation and Sustainable Utilization of Chinese Academy of Sciences, Guangdong Provincial Key Laboratory of Digital Botanical Garden, and Guangdong Provincial Key Laboratory of Applied Botany.

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June 2020

Contents

Gansu

Guangdong

Guangxi

Guizhou

Chapter 1

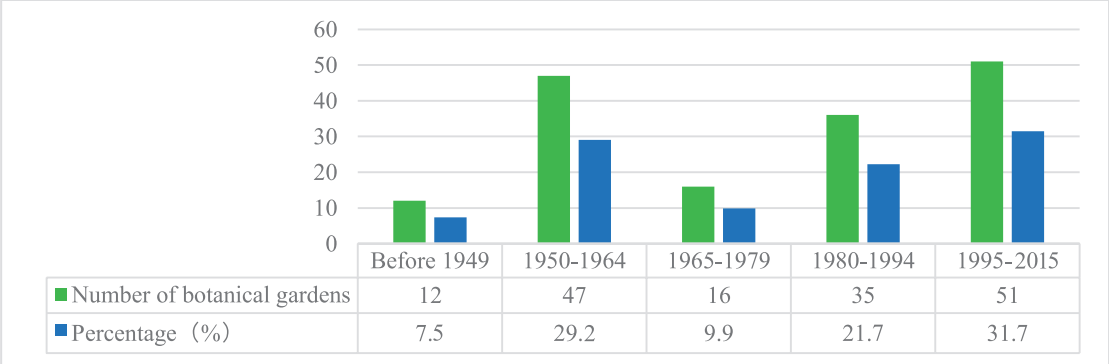
Outline of the Chinese Botanical Gardens

China is one of the most plant-rich countries in the world, with about 33,000 higher vascular plants, second only to Brazil, ranking second in the world (Huang and Zhang, 2012). There are 2,322 ferns in China, 250 species of gymnosperms, and 30,503 angiosperms, accounting for 18%, 26%, and 10% of the world total respectively (Huang, 2011). China is known as the "mother of gardens" (Wilson, 2004), with a long history of gardening and gardening civilization. The introduction and cultivation of plants in China's botanical gardens are almost synchronous with the modern botanical researches in China. With the establishment of the early modern botanical gardens in China, the introduction and collection of plants have begun as early as the beginning of the 20th century. The collection of living plants has inherited the trajectory and achievements of the scientific research of the modern botanical gardens and constituted the foundation and supporting platform for scientific research in China (Xu et al., 2008; Huang and Zhang, 2012).

1.1 Development, distribution and administrative subordination

According to a survey conducted from 2014 to 2017, there are about 161 botanical gardens and arboreta in China, with three peaks of garden construction (Figure 1). 12 botanical gardens that were established before 1949 are still extant, accounting for 7.5% of the existing botanical gardens and arboreta in China, and two-thirds of which were established by foreigners, such as Hong Kong Zoological and Botanical Gardens (1871), Taipei Botanical Gardens (1896), Hengchun Tropical Botanical Garden (1906), Chiayi Botanical Garden (1908), Xiongyue Arboretum (1915), and so on (Xin, 2004; Huang and Zhang, 2012). At the same time, it was also a tough time for Chinese people to construct their own botanical gardens in China. For example, the arboretum of Jiangsu A-type Agricultural School (1915) founded by Chen Rong, and the Jianqiao Botanical Garden (1928, now the botanical garden of Zhejiang University) (Shan et al., 2008) founded by Zhong Guanguang, Lushan Botanical Garden, Chinese Academy of Sciences (1934) founded by Hu Xiansu, Chen Fenghuai, Qin Renchang, etc., mainly take the teaching, plant resource investigation, and plant collection as the main goals.

There were 47 botanical gardens constructed from 1950 to 1964, which was the first peak for the botanical garden construction in China and also the stage of restoration, reconstruction, exploration, and development of modern botanical gardens in China. For example, the restoration of the Lushan Botanical Garden (Jin, 1964; Wang, 1986; Yang, 1994), and the restoration and reconstruction of Nanjing Botanical Garden Mem. Sun Yat-sen (Wang, 1986, 1991; Wang and Hu, 1993). In this period, the construction of botanical gardens in China was led by the modern botanical Gardens of Chinese Academy of Sciences (CAS), such as Kunming Botanical Garden (1938), Shenyang



	Before 1949	1950-1964	1965-1979	1980-1994	1995-2015
Number of botanical gardens	12	47	16	35	51
Percentage (%)	7.5	29.2	9.9	21.7	31.7

Figure 1 The development of Chinese botanical gardens and arboreta

Arboretum of Institute of Applied Ecology (1955), South China Botanical Garden (1956), Beijing Botanical Garden (1956), Dinghushan Arboretum (1956), Wuhan Botanical Garden (1956), Guilin Botanical Garden (1958), Xishuangbanna Tropical Botanical Garden (1959), etc., with the main task of plant resource investigation, introduction and domestication, research and resource application. These botanical gardens also became the core of Chinese modern botanical gardens and the leader of botanical garden construction. At the same time, the botanical gardens of other departments were established successively, such as Medicinal Botanical Garden of Shenyang Pharmaceutical University (1955), Arboretum of Shandong Agricultural University (1956), Beijing Teaching Botanical Garden (1957), Pharmaceutical Arboretum of China Pharmaceutical University (1958), Botanical Garden of Shandong College of Traditional Chinese Medicine (1958) of education departments, the Arboretum of Guangxi Academy of Forestry (1956), Arboretum of the Inner Mongolia Academy of Forestry (1956), Heilongjiang Forest Botanical Garden (1958), Huangshan Arboretum of Anhui Academy of Forestry (1958), Kunming Arboretum of Yunnan Academy of Forestry (1959), Arboretum of Guizhou Academy of Forestry (1963), Nanning Arboretum (1963) of forestry departments, Beijing Botanical Garden (1956), Moshan Landscape Botanical Garden (1956), Hangzhou Botanical Garden (1956), Shenyang Botanical Garden (1959), Xiamen Botanical Garden (1960) of garden departments, Beijing Medicinal Botanical Garden (1955), Xishuangbanna Medicinal Botanical Garden (1959), Xinglong Tropical Medicinal Botanical Garden (1960), Guangxi Medicinal Botanical Garden (1959) of pharmaceutical departments, Hainan Tropical Botanical Garden (1958) of agricultural departments, Xi'an Botanical Garden (1959) of science and technology departments. China has begun to explore the key points of the construction of botanical gardens, and their development and positioning in different industries and systems, and given supports for the development of various industries. The botanical gardens that were established during this period focused on plant investigations, introduction and domestication, and related basic botanic research, and played an active role in the modern botanical garden constructions and plant resource investigations in China, and the construction of modern plant science.

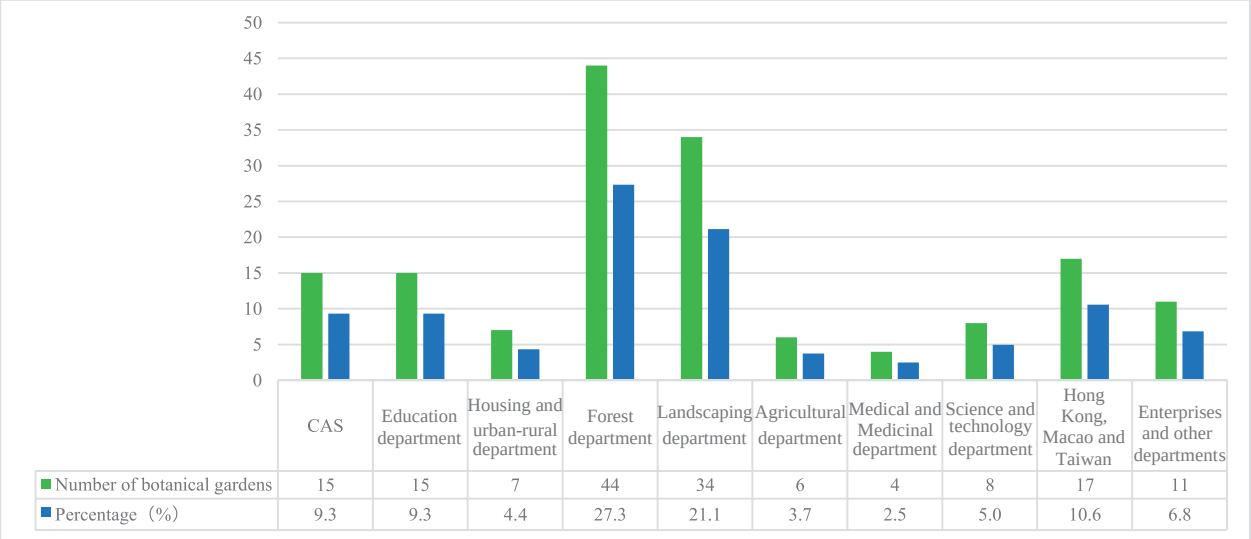
Between 1965 and 1979, 16 botanical gardens were constructed. During this period, botanical gardens in China gradually transitioned from the relatively stagnant stage (1966–1976) to the restoration and construction stage. Many of the botanical gardens in this period suffered from the stagnant operations and deserted gardens. Botanical gardens and their management works were gradually restored after 1976.

Between 1980 and 1994, 35 botanical gardens were constructed. The construction of botanical gardens in China entered a stage of rapid development, and the second peak of construction took place. Various industries and systems continued to establish new botanical gardens, which enriched plant types, optimized the structure of botanical gardens, and played the comprehensive functions of botanical gardens and supported the development of different industries. In order to meet the needs of the public, many botanical gardens continued to enhance the landscaping. Botanical gardens started to take the protection of native plants and rare and endangered plants as the main work, and strengthened public education and science popularization tourism.

Since 1995, Chinese botanical gardens have experienced the third peak of construction. Between 1995 and 2015, 51 botanical gardens were established. At present, the construction of Chinese botanical gardens has entered a stage of steady development (Figure 1), and takes plant collection, scientific research, *ex situ* conservation, public education and sustainable use of plant resources as the main purposes. The overall development of Chinese botanical garden is synchronized with the international modern botanical garden but unique, especially in the excavation and utilization of plant resources. Obviously, the conservation and sustainable use of plant diversity has become an important task in botanical gardens. The pattern of Chinese botanical gardens has entered the stage of scientific botanical gardens where multiple models of botanical gardens coexist.

According to the distribution of natural geographical regions, the geographical distribution of Chinese botanical gardens has covered China's major climate regions, 32 distributed in tropical humid regions, 68 in subtropical regions and 61 in temperate regions, but none in frigid zone of Qinghai-Xizang Plateau. In the future, the construction of botanical gardens in the plateau frigid zone, cold temperate zone, and extreme environmental areas should be strengthened.

The Chinese botanical gardens and arboreta are operated and managed according to an administrative affiliation, mainly including Chinese Academy of Sciences, education department, housing and urban-rural department, forest department, landscaping department, agricultural department, medical and medicinal department, science and technology department, Hong Kong, Macao and Taiwan (Figure 2). Among them, Chinese Academy of Sciences has 15 botanical gardens and arboreta,



	CAS	Education department	Housing and urban-rural department	Forest department	Landscaping department	Agricultural department	Medical and Medicinal department	Science and technology department	Hong Kong, Macao and Taiwan	Enterprises and other departments
Number of botanical gardens	15	15	7	44	34	6	4	8	17	11
Percentage（%）	9.3	9.3	4.4	27.3	21.1	3.7	2.5	5.0	10.6	6.8

Figure 2 Numbers and administrative subordination of the Chinese botanical gardens and arboreta

accounting for 9.3% of the total number of existing botanical gardens. Fifteen in the education department, accounting for 9.3%. Seven in the housing and urban-rural department, accounting for 4.3%. Forty-four in the forest department, accounting for 27.3%. Thirty-four departments in the landscaping department, accounting for 21.1%. Six in the agricultural department, accounting for 3.7%. Four in the medical and medicinal department, accounting for 2.5%. Eight in the science and technology department, accounting for 5.0%. Seventeen in Hong Kong, Macao and Taiwan, accounting for 10.6%. Eleven in enterprises and other departments, accounting for 6.8%. At present, the botanical gardens established and managed by enterprises are growing. Botanical gardens with different affiliations differ in the roles and focuses of botanical garden functions and biodiversity conservation, scientific research, horticultural display, and public education.

1.2 Cultivation facilities and staff

The Chinese botanical gardens have made great progress in plant *ex situ* conservation and staff construction, and have become an important force in the international botanical gardens. At present, the total area of Chinese botanical gardens has reached 102,007.4 hm^2, of which 5,400.1 hm^2 are for specific collections, 1,014.8 hm^2 for plant conservation or nursery, and 76,171.7 hm^2 for natural vegetation. (Table 1). China has built *ex situ* conservation experimental facilities of a certain scale, 49 of which have micro-propagation facilities with an area of 36,745 m^2, 26 of which have seed banks or seed specimen banks with an area of 11,962 m^2, 54 of which have specimen arboreta with an area of 30.4 hm^2. In addition, 45 botanical gardens in China have herbaria with an area of 51,783 m^2 and 104.46 million herbarium specimens.

Chinese botanical gardens and arboreta have established a large-scale workforce. The total number of employees is 11,227, including 2,876 scientific researchers, accounting for 25.6% of the total number, 2,937 landscaping and horticulture managers, accounting for 26.2%, 1,161 science popularization education personnel, accounting for 10.3% (Figure 3).

There are 103 well-known botanical specialty experts, eight internationally renowned botanical experts, 50 experts take up commissioner and above positions in the national botanical society, botanical garden society or association, and 38 experts take up deputy director and above positions in the provincial botanical society or association, which have formed a certain influence in the field of international botanical gardens and plant *ex situ* conservation.

Table 1 Acreage of botanical gardens, specific living collection gardens, conservation or nurseries and natural vegetations

	Total areas of botanical gardens (hm^2)	Areas of gardens for specific collections (hm^2)	Areas of conservation/ nursery (hm^2)	Area of natural vegetation (hm^2)
CAS	68,319.7	730.0	125.6	59,488.2
Education department	3,600.4	3.7	3.4	13.3
Housing and urban-rural department	3,472.3	184.6	31.4	116.9
Forest department	15,343.4	1,527.4	216.9	13,269.9
Landscaping department	4,691.0	887.7	139.8	793.8
Agricultural department	1,866.5	1,048.7	392.0	375.9
Medical and medicinal department	253.4	68.7	2.9	44.0
Science ang technology department	1,063.2	91.3	28.3	703.0
Hong Kong, Macao and Taiwan	1,864.6	53.2	34.2	420.0
Enterprises and other departments	1,532.9	804.8	40.3	946.7
Total area	102,007.4	5,400.1	1,014.8	76,171.7

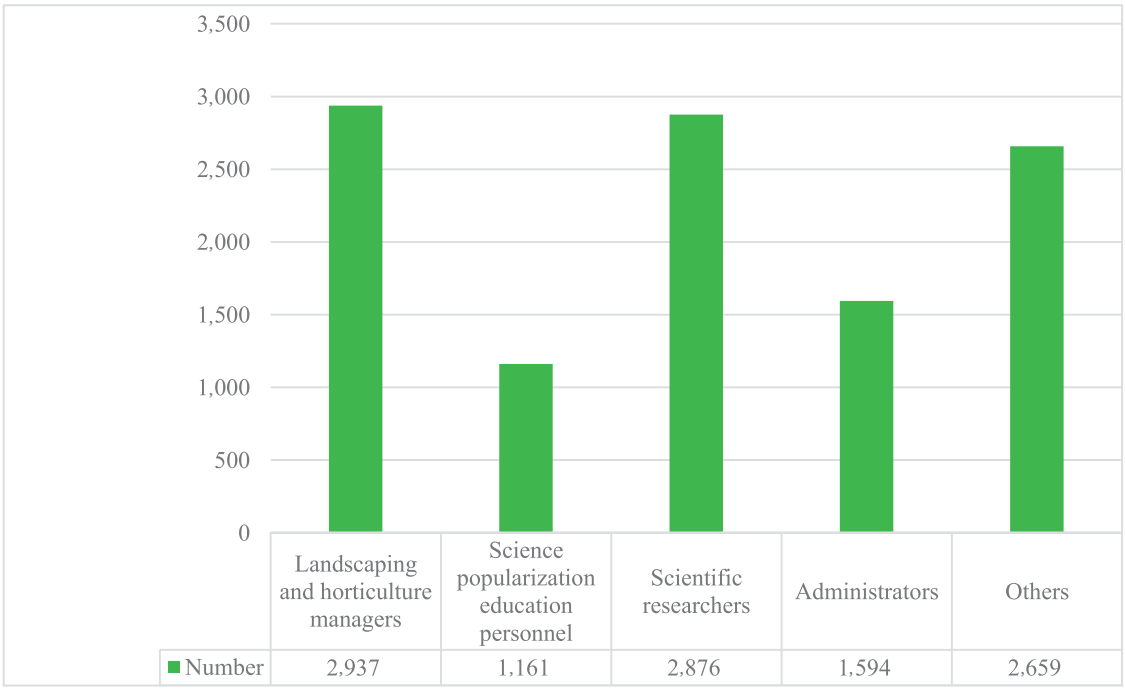


Figure 3 Staff composition of the Chinese botanical gardens and arboreta

1.3 Living collections and *ex situ* conservation

The survey results of accessions, cultivated species, cultivated taxa, rare and endangered plants, medicinal plants, national and local endemic plants, specialized living collection gardens, trees and unidentified accessions of Chinese botanical gardens and arboreta showed that accession number of living collections and cultivated species is 387,749. Among them, the accession number of living plants registered by the botanical garden of Chinese Academy of Sciences is 303,450, which is the highest, accounting for 78.26% of the total number of registered living plants. The number of living plants is followed by the botanical garden of landscaping department, forest department, Hong Kong, Macao and Taiwan, and medical and medicinal department with 39,276 (accounting for 10.13%), 20,305 (accounting for 5.24%), 11,296 (accounting for 2.91%) and 9,272 (accounting for 2.39%) respectively. The accession numbers of agricultural department and science and technology departments are fewer, being 1,800 and 2,350 respectively, accounting for 0.46% and 0.61%. No accession management in the education department, housing construction department and the enterprises and other botanical gardens (Table 2). It can be seen that the Chinese botanical gardens should strengthen the accession management of living plant collection.

There are 250,829 species and 316,316 taxa of cultivated plants in Chinese botanical gardens and arboreta. The numbers of Chinese and local endemic plants, and rare and endangered plants of the cultivated plant are 33,634 and 10,556, respectively. According to a sample survey of *ex situ* conservation plants in 11 major botanical gardens in China, there are 396 families, 3,633 genera and 23,340 species of *ex situ* conserved plants in Chinese botanical gardens, including. 288 families, 2,911 genera and about 20,000 species of native plants, accounting for 91% of the family (total 315 families), 86% of the genera (total 3,405 genera) and 60% of the species (total about 33,000 species) in native vascular plants of China, respectively (Huang and Zhang, 2012). According to the plant directory of *Flora of China*, we correct and eliminate the repeated species and infraspecific taxa, and the number of species of cultivated plants in the Chinese botanical gardens is about 20,000, which covers about 60% of the total number of plants in China (Huang and Zhang, 2012). The plants introduced from abroad are mostly landscape flowers, economic plants, and important resource plants. The living collections and cultivation of Chinese botanical gardens and arboreta have formed the core and backbone of China plant *ex situ* conservation. Based on about 18,000 plant species cultivated in 12 major botanical gardens with large scale and good data accumulation in China, a total of 15,812 species (including 181 subspecies, 932 varieties, 68 forms) were collected. Ferns (according to Qin Renchang's system of 1978) include a total of 835 species, 168 genera and 59 families (including one subspecies, 26 varieties and five forms). Gymnosperms (according to Zheng Wanjun's system of 1975) include a total of 12 families, 53 genera and 299 species (including 26 varieties and one form). Angiosperms (according to the Engler system of 1964) include a total of 241 families, 2,960 genera, 14,678 species (including 180 subspecies, 877 varieties, and 62 forms) (Huang, 2014). According to the preliminary analyses and statistics, the prior introduction and collection taxa, and cultivated taxa of the Chinese botanical gardens and arboreta have 51 families with more than 100 species and 34 genera with more than 50 species (Table 3). The results show that the concentrated collection and key *ex situ* cultivation of botanical gardens and arboreta in China are mainly distributed in the 51 families and 34 genera, and 15,199 species of living plants are collected and *ex situ* cultivated, which have played a positive role in the conservation of native plants in China.

The introduction and conservation of rare and endangered plants in the Chinese botanical gardens and arboreta began in the 1980s, in sync with the international modern botanical gardens (Huang and Zhang, 2012). In the early days, it mainly focused on the rare and endangered plants listed in the *Red List of Plants in China*. In 1992, 388 rare and endangered plants were included in this book, of which eight species belong to the first class of protection plants, 159 species to the second class, and 211 species to the third class (Fu, 1992). Except for a few species that are difficult to trace in the wild or difficult to cultivate, most of them were cultivated and protected in the botanical gardens. In the past 30 years, with the rapid development of China's economy and society and population growth, the pressure on the natural environment has increased, and the number of endangered species has increased. According to recent research, the number of endangered and threatened (including critically endangered, endangered and vulnerable species) plants in China is as high

Table 2 Living collections of Chinese botanical gardens and arboreta

	Accessions	Species	Taxa	Specialized living collection gardens	National and local endemic plants	Rare and endangered plants	Medicinal plants	Trees	Unidentified accessions
CAS gardens / proportion	303,450/78.26	77,933/31.07	79,337/25.08	262/21.92	24,740/73.56	4,228/40.05	3,942/11.91	405,705/18.35	11,974/29.22
Education department / proportion	0/0	16488/6.57	22723/7.18	117/9.79	254/0.76	760/7.2	6210/18.76	190112/8.6	4625/11.29
Housing and urban-rural department / proportion	0/0	7,341/2.93	8,211/2.60	28/2.34	0/0	7/0.07	78/0.24	42,000/1.9	38/0.09
Forest department / proportion	20,305/5.24	61,351/24.46	90,445/28.59	355/29.71	5,350/15.91	2,176/20.61	5,784/17.48	865,055/39.12	18,703/45.64
Landscaping department / proportion	39,276/10.13	35,309/14.08	47,115/14.89	186/15.56	1,144/3.4	1,819/17.23	2,038/6.16	361,358/16.34	840/2.05
Agricultural department / proportion	1,800/0.46	5,642/2.25	12,818/4.05	37/3.1	1,253/3.73	938/8.89	1,320/3.99	49,530/2.24	810/1.98
Medical and medicinal department / proportion	9,272/2.39	12,289/4.9	14,484/4.58	19/1.59	33/0.1	111/1.05	11,900/35.95	13,500/0.61	3,180/7.76
Science and technology departments / proportion	2,350/0.61	15,595/6.22	15,595/4.93	38/3.18	73/0.22	111/1.05	620/1.87	68,940/3.12	265/0.65
Hong Kong, Macao and Taiwan / proportion	11,296/2.91	8,911/3.55	12,614/3.99	84/7.03	770/2.29	108/1.02	185/0.56	14,863/0.67	145/0.35
Enterprises and others / proportion	0/0	9,970/3.97	12,974/4.1	69/5.77	17/0.05	298/2.82	1,020/3.08	200,000/9.05	400/0.98
Total	387,749	250,829	316,316	1,195	33,634	10,556	33,097	2,211,063	40,980

Table 3 Largest families and genera in *ex situ* cultivation

No.	Family Name	Species of the family (Huang, 2014)	No.	Genus name	Species of the genus (Huang, 2014)
1	Orchidaceae	695	1	*Dendrobium*	92
			2	*Bulbophyllum*	79
2	Gramineae	602	3	*Bambusa*	76
			4	*Phyllostachys*	42
3	Rosaceae	566	5	*Rubus*	103
			6	*Rosa*	73
			7	*Cotoneaster*	56
4	Liliaceae	517	8	*Haworthia*	43
5	Compositae	507			
6	Palmae	492			
7	Euphorbiaceae	348	9	*Euphorbia*	102
8	Zingiberaceae	365	10	*Alpinia*	59
			11	*Zingiber*	50
9	Cactaceae	349			
10	Bromeliaceae	281	12	*Aechmea*	81
			13	*Neoregelia*	43
11	Rubiaceae	297			
12	Araceae	264	14	*Arisaema*	45
13	Lauraceae	255	15	*Cinnamomum*	32
			16	*Machilus*	39
			17	*Lithocarpus*	37
14	Leguminosae	685			
15	Labiatae	250			
16	Gesneriaceae	246	18	*Chirita*	71
17	Magnoliaceae	142	19	*Michelia*	53
			20	*Magnolia*	85
			21	*Manglietia*	35
18	Crassulaceae	87	22	*Sedum*	45
19	Cyperaceae	209	23	*Carex*	69
20	Theaceae	164	24	*Camellia*	76
21	Asclepiadaceae	207	25	*Hoya*	77
22	Ericaceae	191	26	*Rhododendron*	137

Continued

No.	Family Name	Species of the family (Huang, 2014)	No.	Genus name	Species of the genus (Huang, 2014)
23	Begoniaceae	178	27	*Begonia*	160
24	Fagaceae	166	28	*Quercus*	52
			29	*Litsea*	50
25	Acanthaceae	153			
26	Ranunculaceae	172	30	*Clematis*	49
27	Apocynaceae	124			
28	Urticaceae	146	31	*Pilea*	38
29	Moraceae	160	32	*Ficus*	110
30	Scrophulariaceae	141			
31	Myrtaceae	131	33	*Syzygium*	57
32	Oleaceae	127			
33	Umbelliferae	141			
34	Verbenaceae	130			
35	Rutaceae	111			
36	Berberidaceae	132	34	*Berberis*	84
37	Caprifoliaceae	132	35	*Viburnum*	61
38	Araliaceae	121			
39	Saxifragaceae	124			
40	Polygonaceae	103	36	*Polygonum*	49
41	Agavaceae	104			
42	Solanaceae	93			
43	Aloaceae	119	37	*Aloe*	119
44	Vitaceae	84			
45	Primulaceae	100	38	*Primula*	55
46	Cucurbitaceae	92			
47	Iridaceae	109	39	*Iris*	64
48	Myrsinaceae	90	40	*Ardisia*	53
49	Rhamnaceae	90			
50	Amaryllidaceae	66			
51	Celastraceae	82			
52	Aizoaceae	118			
53	Aceraceae	106	41	*Acer*	103
54	Annonaceae	93			

Continued

No.	Family Name	Species of the family (Huang, 2014)	No.	Genus name	Species of the genus (Huang, 2014)
55	Aquifoliaceae	87	42	*Ilex*	87
56	Cycadales	240	43	*Cycas*	46
57	Dioscoreaceae	66	44	*Dioscorea*	66
58	Costaceae	45	45	*Costus*	45
59	Actinidiaceae	65	46	*Actinidia*	
60	Ebenaceae	48	47	*Diospyros*	47
61	Dryopteridaceae	151	48	*Dryopteris*	53
			49	*Polystichum*	45
62	Polypodiaceae	102			
63	Aspleniaceae	57	50	*Asplenium*	47

as 3,782 (Wang and Xie, 2004). The number of rare and endangered species in the botanical gardens lags behind the demand for endangered plant protection in China. At present, the number of endangered and threatened plants in Chinese botanical gardens is about 1,500, which is about 39% of the number of endangered and threatened plant species recorded in China. Among them, 483 genera and 1,428 species that cultivated in 11 botanical gardens, such as South China Botanical Garden are endangered and threatened plants (Huang and Zhang, 2012).

The specialized living collection gardens are not only an important platform for plant collection, protection, excavation, and utilization, but also comprehensively experimental bases for further study of specific plant groups, and plays an important role in plant *ex situ* conservation and research (Huang and Zhang, 2012). The Chinese botanical gardens and arboreta currently have 1,195 specialized living collection gardens, of which the numbers of specialized living collection gardens established by the forest department, Chinese Academy of Sciences and the landscape department are among the largest, with 355, 262 and 186, respectively, accounting for 29.71%, 21.92% and 15.56% of specified plant gardens (Table 2). The collection of living plants in Chinese botanical gardens covers all types of international modern botanical gardens, including taxonomic collections, biogeographical collections, conservation collections, native collections, research collections, and display collections. The taxonomic collection is the core type of living plant collection in Chinese botanical gardens, such as the Magnoliaceae garden, Palmae garden, rose garden, *Rhododendron* garden, kiwi garden, *Camellia* garden, medicinal plant garden, Pteridophytes collections, gymnosperm collections, and endemic plant collections. The biogeographic collection is another core type of living plant collection in Chinese botanical gardens, including plant collection of special ecological types based on similar ecological conditions, such as the aquatic botanical garden, rock garden, desert plant areas, halophyte garden, and plant collection of key groups or priority conservation groups from the same geographical area or habitat, such as the Australian botanical garden, East China flora garden, and Southwest Yunnan plant area. Conservation collection is the most important collection of *ex situ* conservation for endangered species, and is the plant collection for conservation biology research, public education, domestic or international plant protection projects. Native plant collection is the collection of endemic plants in specific areas. Research collections are collections of living plants based on specific research needs and research interests. In principle, the entire living plant collection of botanical gardens can be regarded as a research-oriented collection based on *ex situ* conservation, which can be used for scientific research based on living plant collection. Research collections based on research or research projects can enhance the collection of living plants in botanical gardens and enhance the species representativeness and scientificity of living plant collections. For example, the collections of Zingiberaceae and Magnoliaceae in South China Botanical Garden and the

compilation of *Flora of China* are close combination and mutual promotion, which eventually reach a higher level of species quantity and quality of conservation.

Although the repeated numbers of living plant collections and specialized living collection gardens in the botanical gardens of different departments are large, the living plant collections and their specialized living collection gardens in the different botanical gardens are usually based on local climatic conditions from the differences in plant groups and species of *ex situ* conservation. Different botanical gardens conducted the targeted collection for plant groups that are suitable for local growing conditions, and have obvious flora characteristics. The specified plant gardens in southern China usually cover important endemic plant groups of the flora of South China and Southwest China, such as Zingiberaceae, Palmaceae, *Cycas*, Dipterocarpaceae, Magnoliaceae, Moraceae, Orchidaceae, the species of important genera distributed in the tropical and southern subtropics. The botanical gardens in northern China mainly collected important gymnosperm, temperate, and arid plant groups in the flora of Northeast, North and Northwest China. Botanical gardens in Central and Southwest China have systematically collected the important groups of evergreen broad-leaved forests in China, such as *Camellia*, Fagaceae, Polygonaceae, and *Rhododendron* (Table 4).

The collections of conservation groups in specified plant gardens focus

Table 4 Featured gardens of living collections in main Chinese botanical gardens belonging to CAS

Gardens of living collections	Number of species	Living collections and taxonomic representatives
South China Botanical Garden, CAS		
Magnoliaceae garden	259	The Magnoliaceae garden was founded in 1981 with an area of 20.7 hm^2. It collects and displays all the genera of Magnoliaceae and the first, second class national key protected plants, such as *Woonyoungia septentrionalis*, *Pachylarnax sinica*, *Michelia odorum*, *Paramichelia baillonii*
Zingiberaceae garden	307	The Zingiberaceae garden was founded in 1983 with an area of 7.3 hm^2. It collects and displays the main genera of Zingiberaceae and Zingiberales, *Costus*, *Alpinia*, *Heliconia*, *Musa*, *Amomum*, *Curcuma*, *Stahlianthus*, and rare and economical species, *Etlingera yunnanense*, *Orchidantha chinensis*, *Musella lasiocarpa*, *A. oxyphylla*
Orchidaceae garden	1,327	The Orchidaceae garden was founded in 1983 with an area of 1.2 hm^2. It collects and displays more than 200 species of wild orchids, about 1,000 species of tropical orchids, and threatened and endangered species, such as *Paphiopedilum armeniacum*, *P. concolor*, and *P. purpuratum*
Palmae garden	395	The Palmae garden was founded in 1959. It consists of a display area and a conservation area, covering an area of 3.0 hm^2. Endemic species, endangered species and economic species are planted in conservation area, such as *Caryota obtusa*, *Chuniophoenix hainanensis*, *C. nana*, *Trachycarpus nana*, *Guihaia argyrata*, *Adonidia merrillii*, *Phoenix sylvestris*, *Arenga engleri*, *P. canariensis*
Bamboo garden	300	The Bamboo garden was founded in 1961 with an area of 10 hm^2. It collects and displays the endemic species, endangered species and economic species, such as *Acidosasa chinensis*, *Chimonobambusa tumidissinoda*, *Bonia saxatilis*, *Oligostachyum shiuyingianum*, *O. nuspiculum*, *Phyllostachys aurea*, *P. nigra*, *C. quadrangularis*, *Bambusa multiplex* cv. Alphonse-Karr, *Dendrocalamus brandisii*
Cycas garden	95	The *Cycas* garden was founded in 1983 with an area of 3.0 hm^2. It collects and displays all the wild species and endangered species of *Cycas*, such as *Cycas fairylakea*, *C. hainanensis*, *C. changjiangensis*, *C. panzhihuaensis*, *C. debaoensis*
Bromeliaceae garden	203	The Bromeliaceae garden was founded in 1978 with an area of 1.7 hm^2. It displays more than 200 species of ornamental pineapples and tropical fruit trees, such as *Coffea arabica* and *Synsepalum dulcificum*
Economic plants garden	205	The economic plants garden was founded in 1959 with an area of 5.3 hm^2. It collects and displays the aromatic, oil and dye plants, such as *Pimenta racemosa*, *Liquidambar formosana*, *Elaeis guineensis*, *Camellia polyodonta*, *C. crapnelliana*, *Vernicia fordii*, *Aleurites montana* and *Bixa orellana*
Threatened and endangered plants garden	88	The threatened and endangered plants garden was founded in 1983 with an area of 5.3 hm^2. It collects and displays the rare and endangered species, such as *Cathaya argyrophylla*, *Euryodendron excelsum*, *Taxus wallichiana* var. *mairei*, *Amentotaxus yunnanensis*, *Bretschneidera sinensis*, *Nyssa yunnanensis*, *Cephalotaxus oliveri*, *Calocedrus macrolepis*, *Keteleeria pubescens*, *Pinus kwangtungensis*, *Taiwania cryptomerioides*, *Hopea hainanensis*

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Xishuangbanna Tropical Botanical Garden, CAS		
Fragrant plants garden	104	The fragrant plants garden covers an area of 5.7 hm^2, it has introduced 104 species of important spice plants at home and abroad, including the world famous spices, such as *Cananga odorata*, *Syzygium aromaticum*, *Santalum album*, *Aquilaria sinensis*, *Vanilla planifolia*, *Myristica fragrans*, *Myroxylon pereirae*, *M. balsamum*, *Cinnamomum verum*, *C. cassia* and *Michelia* × *alba*, etc., important local spice plants such as *Cinnamomum tenuipile*, *Elsholtzia communis*, *Cinnamomum heyeanum*, *C. parthenoxylon*, etc., and traditional ethnic spices of Dai people, such as *Eryngium foetidum*, *Gmelina arborea* and *Mesua ferrea*, etc.
Wild edible plants garden	400	The wild edible plants garden was founded in 2009 with an area of 10 hm^2. It collects and preserves about 400 species of wild edible and cultivated plants, and it divides into wild edible fruit area, a wild edible flower area, wild edible stem and leaf area, wild edible root area. The relative species of wild cultivated plants are dotted in various areas. It has the largest collection of wild edible plants and the largest area in the world. Representative plants include *Citrus maxima*, *Mangifera indica*, and *Musa* cv. as well as famous tropical fruits and some wild fruit trees
Palmae garden	458	The Palmae garden was founded in 1976 with an area of 9.3 hm^2. It preserves with the national protected plants, such as *Chuniophoenix hainanensis*, *Chuniophoenix nana*, *Caryota obtusa*, *Trachycarpus nanus*, and the endemic species of China, such as *Wallichia disticha*. It also collects and preserves *Salacca zalacca* and *Bactris gasipaes*. *Calamus caesius* and *C. exilis* from the Philippines. The rattan collection area collects 35 species of *Calamus*, *Daemonorops*, and *Plectocomia*, and the high-quality vines include *Calamus acanthospathus*, *C. tetradactylus*, *C. gracilis*, and *C. henryanus*
Tropical plant germplasm collection	1,000	The tropical plant germplasm collection was founded in 2001 with an area of 6.7 hm^2. It collects and cultivates about 1,400 accessions of plant germplasm resources in tropical regions, and about 1,000 species in 130 families, including more than 20 species of national rare and endangered plants. Representative species include *Rhododendron hancockii*, *Elaeocarpus prunifolius*, *Castanopsis calathiformis*, *Epiprinus siletianus*, *Celtis timorensis*, *Neonauclea griffithii*, and *Linodera ramiflora*, etc.
Southern China medicinal plants garden	500	The southern China medicinal plants garden was founded in 2001 and expanded in 2012 with an area of 3.3 hm^2. It collects and preserves nearly 500 kinds of medicinal plants. It is a collection area for ethnic medicinal plants mainly containing southern China medicinal plants, Dai medicinal plants, and Hani medicinal plants. Southern China medicinal plant area preserves and displays more than 30 kinds of plants, including *Dracaena draco*, *Areca catechu*, *Alpinia oxyphylla*, *Amomum villosum*, *Cinnamomum cassia*, *C. verum*, *Santalum album*, *Hydnocarpus kurzii*, *Strychnos nux-vomica*, *Rauvolfia verticillata*, *Caesalpinia sappan*, *Acacia catechu*, *Croton tiglium*, *Erythroxylum novogranatense* etc. Chinese medicinal plants area preserves *Catha edulis*, *Toricellia angulata*, *Datura stramonium*, *Aloe vera* var. *chinensis*, *Cyathula officinalis*, *Citrus medica* var. *sarcodactylis*, *Plantago major*, *Curculigo orchioides*, and *Flemingia prostrate* etc. Ethnic medicinal area displays Thai, Hani and Jinuo medicinal plants, including *Leea macrophylla*, *Tadehagi triquetrum*, *Passiflora wilsonii*, and *Hedychium flavum* etc.
Ficus tree garden	150	The *Ficus* tree garden was founded in 1996 with an area of 1.3 hm^2. It collects and preserves about 150 species of *Ficus* plants. Among them, *Ficus auriculata*, *F. oligodon*, *F. callosa*, *F.altissima*, *F. racemosa*, *F. vasculosa*, *F. virens*, etc. are local wild woody vegetables or ethnic medicinal plants. *F. altissima*, *F. benjamina*, *F. religiosa*, *F. curtipes*, *F. auriculata* have formed a near-natural rainforest landscape
Dipterocarp garden	54	The dipterocarp garden was founded in 1981 with an area of 6.7 hm^2. It successfully introduced seven genera and 34 species of Dipterocarpaceae plants, and representative plants include *Dipterocarpus tuberculatus*, *Parashorea chinensis*, *D. gracilis*, *Hopea hainanensis*, *H. hongayensis*, *Vatica guangxiensis*, *D. retusus*, etc.
Dracaena garden	78	The *Dracaena* garden was founded in 2002 with an area of 1.07 hm^2. It collects and cultivates 78 species and varieties, including 31 species of the genus *Dracaena*, all species distributed in China. This garden also collects and cultivates 30 species of genus, such as *Cordyline*, *Agave*, and *Yucca*
Wuhan Botanical Garden, CAS		
Actinidia national germplasm repository	57	The *Actinidia* national germplasm repository covers an area of 4.0 hm^2 and collects 57 species of *Actinidia* and 30,000 germplasm resources. It is the national resource with the largest collection of kiwi fruit species in the world
Aquatic plant garden	441	The aquatic plant garden consists of a community display area, lake ecological area, lotus variety storage area and display area, aquatic greenhouse, aquatic plant germplasm resources and water lily variety preservation area, including the main groups of aquatic plants in China, such as aquatic rare and endangered *Isoetes japonica*, *I. sinensis*, *Oryza officinalis*, *Ceratopteris pteridoides*, *Ranalisma rostrata*, *Sagittaria tengtsungensis*, *Hygroryza aristata*, etc., and aquatic vegetable germplasm resources such as *Nasturtium officinale*, *Typha orientalis*, *Brasenia schreberi*, *Ottelia acuminate*, *Trapa natans*, *Zizania latifolia*, *Colocasia esculenta*, etc.

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Central China relic and rare plant garden	1,750	The central China relic and rare plant garden covers an area of 14 hm^2 and is a specialized living collection garden that preserves rare and endangered plants. There are nine areas including plant community area of the Three Gorges draw-down zone, endemic and rare plant display area of the Three Gorges, endemic and rare plant preservation area of the Three Gorges, China endemic plant ecological conservation display area, Red Maple Valley area, China endemic genus special area, Central China rare plant display area, ancient relict plant display area, and ancient rare and endemic plant preservation area with 1,750 species preserved. The national key protected wild plants that have been preserved and displayed are *Ostrya rehderiana*, *Carpinus putoensis*, *Isoetes sinensis*, *Davidia involucrate*, *Bretschneidera sinensis*, *Pachylarnax sinica*, *Parakmeria omeiensis*, *Taxus wallichiana* var. *mairei*, *Gleditsia japonica* var. *velutina*, *Parakmeria yunnanensis*, *Pinus kwangtungensis*, *Tetracentron sinense*, etc.
Medicinal plant garden	1,585	The medicinal plant garden was founded in 1956 with an area of 3.5 hm^2. It includes shady plant conservation area, rock area and Li Shizhen medicine culture science popularization area with more than 1,500 kinds of medicinal plants mainly in Central China, including the national key protected wild herbs *Glycyrrhiza uralensis*, *Coptis chinensis*, *Eucommia ulmoides*, *Houpoëa officinalis*, *H. officinalis* cv. 'Biloba', *Phellodendron sinii*, *Eleutherococcus senticosus*, *Scutellaria baicalensis*, *Asparagus cochinchinensis*, *Asarum sieboldii*, *Cornus officinalis*, *Forsythia suspense*, and Central Chinese genuine medicinal materials *Pinellia ternate*, *Tetradium ruticarpum*, *Belamcanda chinensis*, *Ligustrum lucidum*, *Chaenomeles sinensis*, etc.
Wild forest and fruit garden	400	The wild forest and fruit garden covers 3.0 hm^2 and has eight areas including wild vine fruit tree area, drupe area, pome fruit area, subtropical evergreen fruit tree area, dried fruit area, raspberry area, small fruit area and varieties improvement area. There are a total of more than 400 species with 263 new wild fruit tree germplasm resources. The important representative plants have endangered plant *Actinidia suberifolia*, and endemic plants *Armeniaca hongpingensis*, *Prunus cantabrigiensis*, *Stranvaesia amphidoxa*, *Citrus hongheensis*, *Atalantia buxifolia*, *Actinidia melanandra*, etc.
Orchid garden	528	The orchid garden covers an area of 1.45 hm^2 and has five areas including orchid germplasm resources nursery, Orchidaceae plant conservation area, the orchid varieties preservation area, orchid plant seedling propagation and product flower scale production area, and orchid plant facility conservation area. 266 species of orchids have been collected and preserved in Central and South China, and more than 60 species of rare and endangered plants have been preserved *in vitro*
Domestic gardening plants garden	500	The domestic gardening plants garden covers an area of 3.3 hm^2 and collects and preserves 500 wild gardening plants of courtyard trees, street trees, vine plants, hedgerow plants, ground cover plants, wild flowers, shrubs and bonsai gardens. It is a comprehensive gardening plant germplasm resources nursery, and mainly collects the domestic gardening plant resources in Central China
Beijing Botanical Garden of Institute of Botany, CAS		
Arboretum	1,000	More than 1,000 taxa of trees and shrubs of 196 genera belonging to 66 families are collected and cultivated. Different sections are divided into collections of the Rosaceae, Oleaceae, Caprifoliaceae, Berberidaceae, Moraceae, Ulmaceae and Aceraceae etc. Among them, 338 taxa of 45 species of Fagaceae. Excellent tree species have 27 species and 120 taxa, including *Metasequoia glyptostroboides*, *Eucommia ulmoides*, *Pinus wallichiana*, *Berberis thunbergii* cv. Atropurpurea, *Rhus typhina*, *Kolkwitzia amabilis*, *Abelia chinensis*, *Chionanthus retusus*, *Kerria japonica*, *Wisteria sinensis* f. *alba* and *Syringa oblata*. nine families, 30 genera and more than 200 species of gymnosperms including Ginkgoaceae, Pinaceae, Cupressaceae, Taxaceae, Ephedraceae are preserved, such as *Pinus strobus*, *P. ponderosa*, *P. sylvestris*, and *Sabina occidentalis*, *Picea glauca*, etc.
Magnolia and peony collections	230	The *Magnolia* and peony collections cover an area of 0.6 hm^2. The Magnoliaceae plants are the main scape trees, and more than 200 varieties of tree peony or moudan (*Paeonia suffruticosa*) and more than 30 herbaceous or Chinese peony (*P. lactiflora*) are grown
Herb garden	400	The herb garden covers an area of 1.5 hm^2 and mainly collects medicinal plants in northern China, and takes into account the collection of famous foreign medicinal plants. There are more than 400 species in 76 families and 285 genera. According to the ecological habits of medicinal plants, herb gardens are divided into display areas for shady medicinal plants, foreign medicinal plants, sun medicinal plants, climbing medicinal plants, Chinese medicine prescription plants, toxic medicinal plants and aromatic medicinal plants. Representative species are collected and displayed, such as *Polygonatum sibiricum*, *Glycyrrhiza uralensis*, *Fallopia multiflora*, *Eucommia ulmoides* and foreign pines *Silphium perfoliatum*, *Digitalis purpurea*, etc.

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Bulbs and tuberous rooted plants garden	600	The bulbs and tuberous rooted plants garden covers an area of 0.9 hm^2 and collects nearly 600 species herbaceous flowers and climbing plants belonging to 138 genera and 46 families. The important groups are *Hosta*, *Lilium*, *Iris*, *Clematis* and *Hemerocallis*, etc. It is divided into the sun plants area, the shady plants area, the bulb flowers area, the rock plants area and the climbing plants zone based on the habitat requirements and habits of the plants. Four scenic spots named "Songshi-Xunfang" (In search of flowers among Pines and Rocks)", "Yula-Yingchun" (Magnolias Facing Spring), "Guteng-Xinyun" (Old Vine with New Charm) and "Xuying-Songcui" (Evergreens in Morning Sunshine) are highlighted. Planted here are not only popular bulb flowers such as *Tulipa gesneriana*, *Lilium brownii*, and *Hyacinthus orientalis*, but also Chinese endemic wild plants *Cardiocrinum giganteum* and *Hylotelephium spectabile* with Chinese characteristics. New varieties of *Hemerocallis* cv., *Clematis* cv., *Symphyyotrichum* cv., *Iris tectorum* cv., *Hosta* cv., *Phlox* cv. That cultivated in the botanical garden are displayed
Aquatic and vine plants garden	210	Aquatic flowers and vines from 25 families, 40 genera and 210 species are collected and cultivated. Among them, there are more than 100 varieties of lotus and water lily. Representative plants have ancient lotus, Sun Yet-sen lotus, Sino-Japanese friendship lotus, and *Euryale ferox* and *Victoria amazonica* that introduced from abroad. Vines have *Wisteria sinensis*, *Campsis radicans*, *Lonicera maackii*, *Celastrus orbiculatus*, *Akebia trifoliata*, *Vitis vinifera* cv. and *Actinidia chinensis*. The plants of *Lagerstroemia*, *Populus*, *Salix*, *Hibiscus*, etc. are also planted
Lagerstroemia garden	80	The *Lagerstroemia* garden covers an area of 1.25 hm^2 with more than 80 varieties of *Lagerstroemia indica*, which are divided into red *Lagerstroemia indica* area, silver *Lagerstroemia indica* area, spring flowers area, summer intoxication area, autumn color area, a *Lagerstroemia indica* square, and a poetry path. It combines plant collection, display, research and enjoyment and is one of the important ornamental plant areas in the botanical garden
Rare and threatened plants garden	82	The open field displays rare and endangered plants of 41 families, 57 genera and 82 species, most of which are unique to China, such as the Tertiary "living fossil" relict plants *Davidia involucrate*, *Liriodendron chinense*, *Sinojackia xylocarpa*, *Calycanthus chinensis*, *Cercidiphyllum japonicum*, *Tapiscia sinensis*, *Metasequoia glyptostroboides*, *Ginkgo biloba*
Wild fruit trees resources garden	150	The wild fruit trees resources garden covers an area of 2.3 hm^2 and is divided into nuts area, berries area, stone fruits area and pome fruits area. It collects and cultivates more than 150 species of 20 genera and 10 families of wild fruit trees in the northeast, northern and northwest areas of China. *Malus*, *Pyrus*, *Crataegus* and *Amygdalus* are the main taxa, and representative plants include *Cerasus tomentosa*, *Padus avium*, *Amygdalus davidiana* and *Armeniaca sibirica*, *Crataegus pinnatifida*, *Malus spectabilis*, *Pyrus betulifolia*, *Cotoneaster acutifolius*, *Juglans sigillata*, *Castanea mollissima*, *Corylus heterophylla*, *Ziziphus jujuba*, *Diospyros kaki*, *Morus alba*, *Rosa rubus*, etc., and are the important material for cultivating excellent varieties of fruit trees
Chinese rose garden	360	The Chinese rose garden covers an area of 0.6 hm^2 and comprises nearly 400 varieties of modern roses. The most notable varieties growing here include 'Yellow Peace', 'Super Star', 'Double Delight', 'Pink Queen', 'Princess', 'Golden Scepter', 'Garden Party', 'Big Purple', 'Facing Spring' and 'Crimson Glory'
Nanjing Botanical Garden Mem. Sun Yat-sen, CAS		
Arboretum	371	The arboretum covers an area of 10 hm^2 and is a research base for the introduction and domestication of subtropical trees in the North and Central of Asia. It collects 371 species of 115 genera and 57 families of woody plants such as Fagaceae, Polygonaceae, Aquifoliaceae, Magnoliaceae and Mapleaceae
Pine and cypress garden	69	The pine and cypress garden covers an area of 7.0 hm^2 and preserves about 69 species of 22 genera and seven families such as Pinaceae, Cedaraceae and Cypressaceae at home and abroad
Medicinal plants garden	800	The medicinal plants garden covers an area of 4.0 hm^2 and is divided into the medicinal plants area of the root and stem, the flower and fruit, the whole plant, the vine and the shady plant according to the medicinal parts and ecological habits. Nearly 800 medicinal plants of 431 genera and 133 families were collected
Threatened and endangered plants garden	100	The threatened and endangered plants garden covers an area of 7.0 hm^2 and preserves more than 100 species of national key preserved threatened and endangered plants
Systematic garden	300	The systematic garden covers an area of 6.0 hm^2 and is arranged according to the Bessey classification system. It is planted more than 300 species of 143 genera and 64 families according to ecological type and garden layout such as *Torreya grandis* and *Pseudolarix amabilis*, *Tsuga chinensis*, *Liriodendron chinense*, *Ormosia hosiei*, *Magnolia obovata*, *Calycanthus chinensis*, etc.

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Rose garden	150	The rose garden aims at collecting rose with 150 varieties as well as the famous flowering plants such as varieties of *Armeniaca mume*, *Magnolia denudata*, *Jasminum nudiflorum*, *Rhododendron simsii*, *Camellia japonica*, *Paeonia suffruticosa* and *P. lactiflora*
Maple garden	20	The maple garden covers an area of 3.0 hm^2 and is planted with more than 20 species of maple trees, such as *Acer palmatum*, *A. buergerianum*, *A. henryi*, *A. sinopurpurascens*, *A. palmatum* cv. Dissectum, *Liquidambar formosana*, *Triadica sebifera*, *Rhus chinensis*, *Pistacia chinensis*, *Elaeocarpus decipiens*, *Lagerstroemia indica*, *Ulmus pumila*, *Zelkova serrate*, *Lindera glauca* and other colored leaf trees
Gramineae garden	400	The Gramineae garden covers an area of 2.0 hm^2 and collects more than 400 plants of more than 100 genera of Gramineae, and is divided into germplasm resources nursery, East China native plant display area, plant function display area and landscape display area. According to the topography and evolution of Gramineae, the main representative species of eight subfamilies such as Bambusoideae and Oryzoideae are planted in turn, showing the systematic evolution of Gramineae
Guilin Botanical Garden, CAS		
Gesneriad Conservation Center of China	300	The Gesneriad Conservation Center of China was founded in 2014, and published the monograph of *Gesneriaceae of South China*. The display area of Gesneriaceae was established and more than 300 species of Gesneriaceae are collected and displayed according to the epiphytic, acidophil, and calciphilous types such as *Primulina ronganensis*, *Oreocharis dayaoshanioides*, *O. sinohenryi*, *Petrocodon jasminiflorus*, *Anna rubidiflora*, *Primulina pupurrea*, *P. cardaminifolia*, *Litostigma coriaceifolium*, etc.
Threatened and endangered plants garden	420	The threatened and endangered plants garden covers an area of 2.0 hm^2 and 420 species of threatened and endangered plants have been introduced and preserved. Flower shrubs and other ornamental plants are properly arranged to beautify and highlight the key endangered plants, making them have more ornamental garden value and become an important place for scientific research and science popularization education. It is also the first specialized living collection garden in China that combines the protection of threatened and endangered plants with the construction of gardening and science popularization facilities. The main representative plants have *Parashorea chinensis*, *Taxus wallichiana* var. *chinensis*, *Malania oleifera*, *Dalbergia odorifera*, *Cephalotaxus fortunei*, *Vatica guangxiensis*, etc.
Rare and exotic plants garden	200	The rare and exotic plants garden covered an area of 1.2 hm^2 and was built in 1999 and completed in 2002. It mainly aims at collecting and displaying the precious, ancient, exotic and interesting plants distributed in the subtropics, especially mainly in Guangxi, which is characterized by rich local characteristics. This garden has three functional display areas according to the precious, rare and exotic features and has introduced more than 200 species of precious, interesting and ancient plants, including the precious ancient plants such as *Alsophila spinulosa*, *Cathaya argyrophylla*, *Platycerium wallichii*, *Asplenium nidus*, the exotic plants such as *Cycas multifrondis*, *Codariocalyx motorius*, *Mimosa pudica*, insect-trapping plants and carnivorous plants, and the special local plants such as famous Guilin Yanshan four treasures: varieties of *Abrus precatorius*, *Chimonobambusa quadrangularis*, *Osmanthus fragrans*, and *Prunus mume* cv. viridicalyx
Golden Camellia garden	134	The golden *Camellia* garden covers an area of 0.8 hm^2 and collects 15 species and two varieties of sect. *Chrysantha*. In order to enrich the garden landscape, more than 50 precious *Camellia* varieties and *Camellia polyodonta*, which is unique to Guangxi are planted. The *Camellia nitidissima* and *Camellia* varieties are all undergrowth, and they are planted along the sightseeing trails with tall arbor camphor trees in the upper layer and shady ground-cover plants laying ground according to the high and low level of the garden planning. The representative species have *C. nitidissima*, *C. euphlebia*, *C. pubipetala*, and *C. impressinervis*, etc.
Rhododendron garden	100	The *Rhododendron* garden was founded in 2000 and covered an area of 4.1 hm^2. It is the first multi-functional *Rhododendron* specialized living collection garden in Guangxi with beautiful landscape, reasonable layout, preservation of germplasm resources, science popularization education and tourism. About 100 species and varieties of *Rhododendron*, including *Rhododendron championae*, *R. discolor*, *R. moll*, *R. wumingense*, etc., have been collected. It is the largest, most diverse and most abundant *Rhododendron* specialized living collection garden in Guangxi and some *Rhododendron* are unique to Guangxi. The *Rhododendron* in the garden are arranged according to the color and flowering period, and are also equipped with ornamental plants such as *Cercis chinensis*, *Sophora japonica* cv. Pendula and *Jasminum nudiflorum*
Osmanthus garden	23	The *Osmanthus* garden was founded in 1997 and covers an area of 1.2 hm^2. This garden collects and plants more than 10 varieties of *Osmanthus fragrans*, *O. fragrans* cv. Semperflorens. *O. fragrans* cv. Rixianggui, and is the highlight of the autumn tour of the botanical garden full of sweet-scented osmanthus fragrance

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Bamboo garden	120	The bamboo garden was founded in 1997 and covers an area of 2.0 hm^2. This garden introduces more than 120 species of bamboos from Guangxi and neighboring provinces, including *Phyllostachys nigra*, *Chimonobambusa quadrangularis*, *Phyllanthus sulphurea*, *Bambusa ventricosa*, and the unique *Monocladus amplexicaulis* in Guangxi
Peach garden	50	The peach garden was founded in 2002 and covers an area of 1.5 hm^2. It is located in the flat of mountainous area in the south of the botanical garden. It introduces and cultivates more than 50 varieties with high ornamental value, such as *Amygdalus persica* cv. *rubro-plena*, *Prunus persica* cv. *atropur purea*. At the same time, this garden is supplemented by other ornamental shrubs of the family Rosaceae
Gymnosperm collection	200	The gymnosperm collection covers an area of 1.3 hm^2, and it is the garden that is earliest established and is open to the public in the botanical garden. It displays more than 200 species of gymnosperms of 40 genera and 10 families. The national protected plants have *Ginkgo biloba*, *Cathaya argyrophylla*, *Metasequoia glyptostroboides*, *Cycas panzhihuaensis*, *Amentotaxus yunnanensis*, *Taxus yunnanensis*, the foreign species have *Araucaria bidwillii*, *Sequoia sempervirens*, *Taxodium distichum* and the world-famous ornamental species have *Cedrus deodara*, *Pseudolarix amabilis* and *Araucaria cunninghamii*
Palm and cycad collections	60	The palm and cycad collections cover an area of 1.3 hm^2, and have collected 12 species of tropical and subtropical palm plants, five species of cycads, and nearly 200 plants in the open field
Kunming Botanical Garden of Kunming Institute of Botany, CAS		
Bamboo garden	63	The bamboo garden covers an area of 0.22 hm^2, and has planted 50 varieties of bamboo (including varieties and variants) and 13 species of ground-cover plants. Representative plants have the tall arbor-like bamboos such as *Neosinocalamus affinis* f. *flavidorivens*, *Bambusa chungii*, the low-lying ground-cover bamboos such as *Shibataea chinensis*, *Sasa pygmaea*, the ornamental stem bamboos *Phyllostachys nigra* and *P. heterocycla* and the ornamental foliage bamboos such as *Sasa fortune* and *Indocalamus latifolius*
Rose family collection	160	The rose family collection covers an area of 2.0 hm^2, and has collected and displayed more than 100 varieties of 25 genera of Rosaceae that are mainly tree-shrubs and vines, including winter-flowering varieties *Cerasus cerasoides* var. *majestica*, *Armeniaca mume*, early spring flowering varieties *Cerasus cerasoides* var. *rubea*, *Malus halliana*, mid-spring flowering varieties *Amygdalus persica* f. *dulex*, *Chaenomeles cathaensis*, late-spring flowering Varieties *Cerasus yedoensis*, *Rosa banksiae*, autumn ornamental fruit varieties *Pyracantha fortuneana*, *Stranvaesia davidiana*, *Cotoneaster adpressus* as well as *Crataegus cuneata*, *Caltaegus pinnafifida* var. *major*, *Docynia delavayi*, *Eriobotrya japonica* and other wild fruit trees that are of health or medicinal value
Camellia garden	672	The *Camellia* garden was completed in 2011, Covering an area of 10 hm^2, it has collected and preserved more than 600 taxa of Theaceae (including varieties, variants, subspecies and cultivars). There are 160 varieties of *Camellia reticulata*, 400 varieties of *C. longicaudata*, 40 varieties of *C. sasanqua*, 16 varieties of *C. nitidissima*. It is an important germplasm resources nursery for collecting and storing *Camellia* horticultural varieties in the world. The important taxa have *Camellia*, *Pyrenaria*, *Polyspora*, *Schima*, *Stewartia*, *Ternstroemia*, *Adinandra*, *Adinandra*, *Euryodendron*, *Eucalyptus* and *Eurya*
Rhododendron garden	270	The *Rhododendron* garden was founded in 2009 and covers an area of 4.0 hm^2. 243 varieties of *Rhododendron* were planted, including 127 native species, seven ornamental species, and 26 other plants
Begonia garden	460	The *Begonia* garden has collected 460 varieties with more than 5,000 pots, and selected 20 new varieties such as *Begonia grandis* cv. Plant Bird and *Begonia grandis* cv. Dabai. This garden is the largest introduction and taming base of begonia in China. Other plants including *Conandron*, *Pedicularis*, and *Clematis*
Arboretum	960	The arboretum covers an area of 10 hm^2, and has collected and displayed Hamamelidaceae, Lauraceae, Fagaceae, Aceraceae, Anacardiaceae, Nyssaceae, Combretaeeae, Araliaceae, Sterculiaceae, Ulmaceae. More than 60 Magnoliaceae species from Yunnan are collected such as *Lirianthe delavayi*, *Michelia chapensis*, *Manglietti insignis*, and *Yulania campbellii*
Herb garden	950	Founded in 1979, it covers an area of 3.0 hm^2 and has collected and preserved more than 950 species of 592 families and 592 genera of medicinal plants in southwestern China, including the Labiatae, Liliaceae. Magnoliaceae, Leguminosae, Ranunculaceae, Campanulaceae, Malvaceae, Cypress, Zingiberaceae, Trillium, etc.
Fuligong conservertories	2,000	The old “Fuligong” greenhouse was founded in 1986 and expanded in 2011. The expanded area of “Fuligong” is 0.65 hm^2, which consists of the main tropical rainforest greenhouse and desert greenhouse, botanical doctors’ gallery, orchid greenhouse, begonia greenhouse, fern greenhouse and stone greenhouse. In 2015, it displayed plants and preserved more than 2,000 species of tropical plants

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Lushan Botanical Garden, CAS		
Coniferous garden	248	The coniferous garden covers an area of 3.0 hm^2 and has collected 248 species (including varieties) of 48 genera, 11 families such as Pinaceae, Taxodiaceae, Cupressaceae, Podocarpaceae, Cephalotaxaceae, and Taxaceae. The representative species have *Taxus wallichiana* var. *chinensis*, *T. chinensis*, *T. cuspidata*, *T. cuspidate*, *T. wallichiana* var. *mairei*, *Pseudotaxus chienii*, *Amentotaxus argotaenia*, *Torreya grandis*, *Sciadopitys verticillata*, *Cathaya argyrophylla*, *Metasequoia glyptostroboides*, *Cephalotaxus sinensis*, *Cephalotaxus fortune*, *Abies firma*, *A. ferreana*, *Fokienia hodginsii*, *Chamaecyparis formosensis*, *Taiwania cryptomerioides*, *Pseudolarix amabilis*, *Pinus strobus*, *Chamaecyparis obtuse* and *Juniperus communis*
Rhododendron garden	320	The *Rhododendron* garden consists of *Rhododendron* classification area, international friendship *Rhododendron* garden, *Rhododendron* returning and introducing garden and Rhododendron valley. A total of more than 320 wild species of *Rhododendron* and nearly 200 varieties are collected, including *Rhododendron fortune*, *R. jingangshanicum*, *R. simiarum*, *R. kiangsiense*, *R. liliiflorum*, *R. latoucheae*, *R. auriculatum*, *R. chihsinianum*, *R. annae*, *R. irroratum*, *R. ovatum* and *R. molle*
Rock garden	600	The rock garden covers an area of 1.0 hm^2 and has introduced more than 600 species of shady plants and medicinal plants. The garden has planed to be cleaned up, expand to 2.0 hm^2, and has preserved the living plants more than 800 species (including varieties)
Fern and moss garden	300	The fern and moss garden covers an area of 1.0 hm^2, and 285 species of 89 genera and 40 families of ferns and 15 species of seven genera and five families of moss have been introduced
Arboretum	140	The arboretum covers an area of 1.3 hm^2 and has preserved 140 species of rare and endangered plants of China. Representative plants include *Bretschneidera sinensis*, *Davidia involucrata*, *Cathaya argyrophylla*, *Taiwania cryptomerioides*, *Taxus wallichiana* var. *chinensis*, *Pseudotaxus chienii*, *Cercidiphyllum japonicum*, *Tapiscia sinensis*, *Emmenopterys henryi* and Magnoliaceae plants
Endemic shrub garden	120	The endemic shrub garden covers an area of 1.2 hm^2, and more than 120 species of native plants have been preserved in Jiangxi. This garden has planed to expand the area to 3.5 hm^2, and preserves more than 180 native plants
Turpan Desert Botanical Garden, CAS		
Tamaricaceae garden	20	The Tamaricaceae garden was founded in 1992 and covers an area of 2.0 hm^2. It has collected and preserved three genera, 20 species of Tamaricacea, including 17 species of *Tamarix*, two species of *Reaumuria*, and one species of *Myricaria*, accounting for more than 50% of the species in China. This garden is an important resource bank and research base for the preservation of Tamaricaceae plants in the world
Ethno-medicinal plants garden	150	The ethno-medicinal plants garden was founded in 1992 and covers an area of 0.5 hm^2. It has collected Uighur wild medicinal plants as well as herbal medicines from other ethnic minorities such as Xinjiang Kazakh and the Mongol. This garden highlights desert species and provides conditions for discovering wild medicinal plant resources in Xinjiang
Desert economical plants garden	50	The desert economical plants garden was founded in 1995 and covers an area of 1.2 hm^2. It has introduced and preserved more than 30 species of wild economic fruits and varieties in arid desert areas, and will be developed into a germplasm conservation center of wild fruit trees and cultivated fruit trees in desert areas. It collects and preserves *Malus sieversii*, *Rosa multiflora*, *Armeniaca vulgaris*, *Amygdalus communis*, *Prunus domestica*, *Crataegus* sp., *Cerasus* sp., *Juglans regia*
Temperate desert rare and endangered plants garden	150	The temperate desert rare and endangered plants garden covers an area of 6.0 hm^2 and collects the endemic, endangered, rare and relic taxa in the temperate desert flora, the key species in typical desert ecosystems, the related species of important cultivated crops, and the wild species with potentially important value
Desert halophyte plants garden	110	The desert halophyte plants garden covers an area of 1.0 hm^2 and has collected plants of Polygonaceae, Tamaricaceae, Zygophyllaceae, Plumbaginaceae, Salicaceae, Compositae, Leguminosae and Gramineae
Desert wild ornamental plant garden	100	The desert wild ornamental plant garden was founded in 1997 and covers an area of 1.0 hm^2. Focusing on the collection of wild ornamental foliage, fruit and shape plants, it has collected and preserved shrub plants, as well as the collection of ground-cover plants and short-lived ornamental plants

Continued

Gardens of living collections	Number of species	Living collections and taxonomic representatives
Desert plant specimens garden	400	The desert plant specimen garden was founded in 1976 and covers an area of 8.0 hm^2. This garden has planted nearly 400 species of 200 genera in 60 families of desert plants. The main functions of the garden are the preservation of desert plant species resources, the systematic study of desert plants in arid areas, scientific popularization and teaching internships. The characteristic plant groups are *Tamarix*, *Calligonum*, *Ammopiptanthus*, *Nitraria*, *Glycyrrhiza* and *Haloxylon*, and their species account for more than 80% of the total distribution of desert areas in China. Many species are unique to China's deserts and the constructive species in the distribution area
Calligonum collections	23	The *Calligonum* collections were founded in 2006 and covers an area of 10.45 hm^2. This garden has the germplasm resources of *Calligonum*. It has collected and preserved the constructive species that are distributed in Xinjiang, such as *Calligonum calliphysa*, *C. leucocladum*, *C. rubicundum*, *C. klementzii*, *C. ebinuricum* and *C. roborowskii*. The garden also has planted with the main associated shrubs and perennial herbaceous plants, which constituted the natural community of *Calligonum*, covering all domestic species of *Calligonum*
West China Subalpine Botanical Garden, CAS		
Chinese Rhododendron garden	1,500	The Chinese *Rhododendron* garden was founded in 1986 and covers an area of 42.9 hm^2. This garden collects and preserves more than 300 varieties of *Rhododendron* with more than 200,000 plants, including the *Rhododendron* core landscape area and the *Rhododendron* return display area. There are also three natural communities distributed at different altitudes of 1800–3400 m. It is the largest and most diverse wild *Rhododendron* resource collection and *ex situ* conservation base in China and even in Asia with *Rhododendron* and *Davidia involucrata*, *Cercidiphyllum japonicum*, *Tetracentron sinense*, and other rare plants

on the native and endemic plants, and the important plant groups of China, such as the Magnoliaceae garden, Palmae garden, Zingiberaceae garden, *Camellia* garden, *Rhododendron* garden, etc. These specialized living collection gardens are large in collection scale, standard in management, rich in research and accumulation, and reflect the floristic characteristics of plants in different regions, and have played a positive role in the protection of native plant diversity in China. For example, magnolia garden of South China Botanical Garden has collected 259 species of Magnoliaceae, which basically covers most of the species of Magnoliaceae distributed in China and important foreign species, and it is also the most comprehensive specialized living collection garden for collecting and conserving Magnoliaceae plants in the world. Most of the Chinese botanical gardens have rare and endangered specialized living collection gardens, which focus on the collection and conservation of endangered plants, especially the key endangered plants in the region. Some large-scale endangered specialized living collection gardens have realized population collection and genetic diversity assessment studies of the key endangered plants in the region, which play a core role in the *ex situ* conservation of endangered plants in China. The specialized living collection gardens are also important parts of the botanical garden engaged in the exploration and utilization of plant resources, and has strong research and development capabilities. Chinese botanical gardens have carried out a considerable number of collection of economic plant groups and construction of specialized living collection gardens, such as medicinal plants, economic plants, fruit trees, ornamental flowers, and other specialized living collection gardens, which play an important role in the exploration and utilization of plant resources in China.

Chinese botanical gardens and arboreta have carried out numerous studies on endangerment mechanisms, breeding strategies and methods, and the theory and technology of field regression, and have made great progress. Chinese botanical gardens and related research institutes have conducted in-depth research on dozens of endangered plant catalogs, biological evaluations, endangerment mechanisms, *ex situ* and *in situ* conservation mechanisms and field regressions in China, and have obtained a number of cases of results that can be used for reference (Ren et al., 2012, 2014). For example, the South China Botanical Garden worked on the field regressions and population expansion of rare and endangered plants, such as *Primulina tabacum*, *Tigridiopalma magnifica*, *Metabriggsia ovalifolia*, *Paphiopedilum wardii*, *Bretschneidara sinensis*, *Manglietia longipedunculata*, *Parakmeria lotungensis*, *Euryodendron excelsum*, *Tetrathyrium subcordatum*, and others. Wuhan Botanical Garden studied the rare and endangered plants in Central China, such as *Myricaria laxiflora*, *Berchemiella wilsonii* var. *pubipetiolata*, *Isoetes sinensis*, *Adiantum nelumboides*, and *Manglietia patungensis*, *Sinokeia rehderiana*,

S. huangmeiensis, *Eurycorymbus cavaleriei*, and others. Kunming Botanical Garden studies the rare and endangered plants in Southwest China, such as *Paphiopedilum malipoense*, *Pachylarnax sinica*, *Cyclobalanopsis sichourensis*, *Paraisometrum mileense*, *Dipteronia dyeriana*, *Magnolia odoratissima*, *Manglietia aromatica*, *Trigonobalanus doichangensis*, *Nyssa yunnanensis*, *Diploknema yunnanensis*, and others. The natural regression experiments and population restoration reconstructions of Hong Kong Kadoorie Farm and Botanic Garden on *Doritis pulcherrima*, Shenzhen Fairylake Botanical Garden on *Cycas debaoensis*, and Lushan Botanical Garden on *Disanthus cercidifolius* var. *longipes* and *Nageia nagi* have also been carried out (Ren et al., 2017). The National Project Planning for Rescuing and Conserving Wild Plants with Extremely Small Population (2011–2015) was issued in recent years and promulgated 120 species of endangered plants with an extremely small population in China, and only about 10 species were relocated and conserved in the botanical garden (Huang and Zhang, 2012). The study on *ex situ* conservation and implementation technology systems for endangered plants with extremely small populations will be one of the important directions for the recent and future research of Chinese botanical gardens.

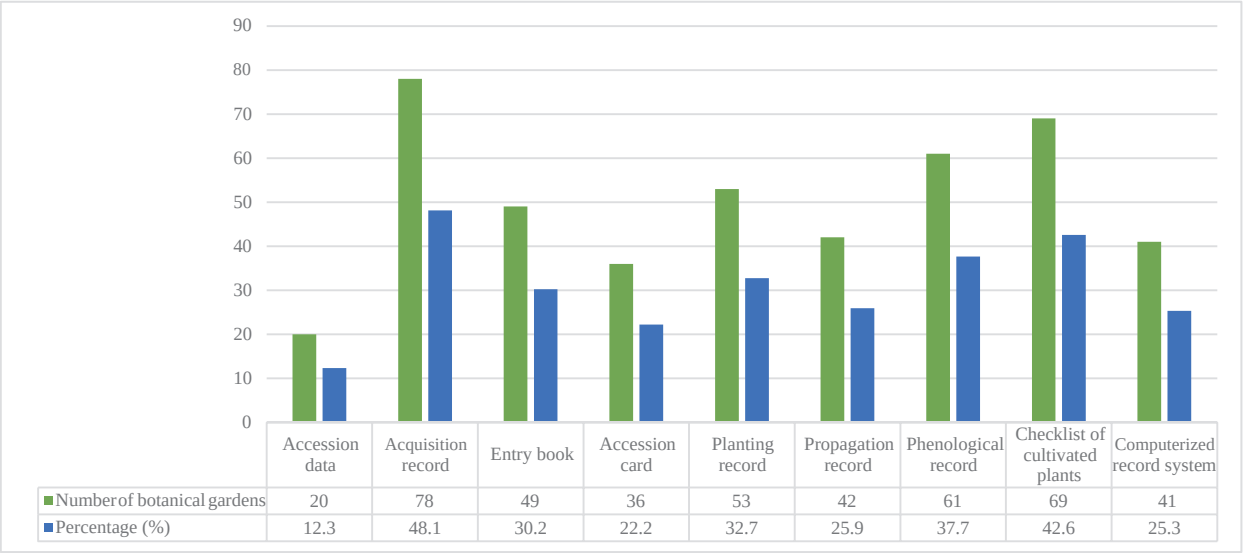
1.4 Plant records and *ex situ* cultivation

Carrying out plant diversity collection and *ex situ* cultivation and conservation is one of the core tasks of the botanical garden, and also the biggest difference between the botanical garden and the park. The information recording and archive management of the *ex situ* conservation plants is the "soul" of the botanical garden. A comprehensive survey of the *ex situ* cultivation records and archives of botanical gardens in Chinese botanical gardens, including acquisition record, entry book, accession card, planting record, propagation record, phenological record, checklist of cultivated plants and computerized record system (Figure 4), shows that there are only 20 botanical gardens in China have accession data, accounting for 12.3% of the total number of botanical gardens. Seven of them are affiliated to Chinese Academy of Sciences, and only a few in other departments, for example, five botanical gardens in the landscaping department, three in Hong Kong, Macao and Taiwan, two in the medical and medicinal department, one in the science and technology department and one in the agricultural department. The lack of accession data in the education department, housing and urban-rural department, enterprises and other botanical gardens urgently needs to be highly valued.

The information management of an introduction and *ex situ* cultivation in the Chinese botanical gardens is seriously inadequate. For example, only 78 botanical gardens have acquisition record, 49 botanical gardens have entry book 36 botanical gardens have accession card, 53 botanical gardens have planting record, and 42 botanical gardens have propagation record, 61 botanical gardens have phenological record, 69 botanical gardens have checklist of cultivated plants, and 41 botanical gardens have computerized record system, all of which are low in proportion (Figure 5). This indicates that most of the botanical gardens in China are imperfect in information recording and archive management. In particular, less than 30% of the botanical gardens have computerized record systems, which seriously lags behind the preservation and sharing of plant information records, meaning that the basic data of archives management and information records for the biodiversity protection of China's botanical gardens is seriously inadequate. And there is still no long-term, stable, and efficient national systems for plant *ex situ* conservation in China (Huang and Zhang, 2012).

Acquisition, accession, propagation, planting, phenological observation, seed and material exchange, invasive biological monitoring, and cultivated plant cataloging in botanical gardens in the Chinese botanical gardens and arboretum need to be strengthened. According to the survey, only 102 (63%) of the Chinese botanical gardens carried out field investigations and introductions, and there were 49 (30.2%), 42 (25.9%) and 53 (32.7%) botanical gardens for accession, propagation and planting management, respectively. 61 (37.7%), 49 (30.2%) and 34 (21.0%) botanical gardens carried out the phenological observation, seed and material exchange, and invasive biological monitoring, respectively. Only 69 (42.6%) botanical gardens carried out *ex situ* cultivated cataloging (Figure 5).

Through investigation, the living plant collection of the botanical garden of Chinese Academy of Sciences and the main members of the Chinese Union of Botanical Gardens was analyzed



	Accession data	Acquisition record	Entry book	Accession card	Planting record	Propagation record	Phenological record	Checklist of cultivated plants	Computerized record system
Number of botanical gardens	20	78	49	36	53	42	61	69	41
Percentage (%)	12.3	48.1	30.2	22.2	32.7	25.9	37.7	42.6	25.3

Figure 4 Statistics of plant record and archive management in Chinese botanical gardens

(Table 5). The results show that the botanical gardens of Chinese Academy of Sciences have long been engaged in the collection, research, discovery and utilization of specific genus and specific family, and some specialized plants. The botanical gardens of CAS have the characteristics of long history, rich accumulation, strong regional representation and strong systematic data accumulation, and plays a significant leading role in the number of accessions (303,450, accounting for 78.26% of the total number of national botanical gardens), *ex situ* conservation species (77,933 species, accounting for 31.07%), nationally and locally endemic species (24,740 species, accounting for 73.56%), rare and endangered species (4,228 species, accounting for 40.05%) (Table 5). The botanical gardens of Chinese Academy of Sciences continued to introduce species with 230,327 collections of new introduction from 2010 to 2016, namely 32,904 collections of annual introduction. The 119 members of Chinese Union of Botanical Gardens have extensive coverage and regional representation, and play a major role in the number of living plant accession (374,420, accounting for 96.56%), and *ex situ* conservation species (155,710 species, accounting for 62.08%), China and locally endemic species (8,173 species, accounting for 24.30%) and rare and endangered species (5,288 species, accounting for 50.09%).

In the national botanical garden system, the top 50 botanical gardens in the number of *ex situ* conservation species, specialized living collection gardens, China and locally endemic species, and rare and endangered species have the botanical garden representativeness and the complete information of *ex situ* conservation, covering 100% of living collection accession, 56.93% of living collection species, 51.13% of taxa, 53.22% of specialized living collection gardens, 24.15% of endemic species, 46.27% of rare and endangered plants, 53.13% of medicinal plants. These top 50 botanical gardens have an extensive representative of *ex situ* collection and play a central role in plant *ex situ* conservation in China. There are about 2,000 species of *ex situ* conservation plants in 11 major botanical gardens in China (Huang and Zhang, 2012), and their living plant accessions covers 76.69% of the total accession of Chinese botanical gardens, 28.02% of living plant collection species, 23.5% of taxa, 17.49% of specialized living collection gardens, 18.92% of nationally and locally endemic plants, 26.16% of rare and endangered plants, 13.37% of medicinal plants (Table 5).

In addition, forest and landscaping departments have particular advantages in terms of the number of botanical gardens, specialized living collection gardens, living collection species and taxa, and trees, with 51 and 39 botanical gardens, 355 (27.27%) and 213 (16.36%) specialized living collection gardens, 61,351 (23.32%) and 37,582 (14.29%) living collection species, 90,445 (27.25%) and 49,443 (14.9%) taxa, respectively. The medicinal plants for *ex situ* cultivation have the largest number in the botanical gardens of the medical or medicinal department, with 13,100 species (33.84%), followed by the botanical gardens of the forest department, education department and Chinese Academy of Sciences, being 5,784 (14.94%), 5,130 (13.25%) and 3,942 (10.18%), respectively. The *ex situ* conservation of nationally and locally endemic plants has a clear advantage in the botanical garden of Chinese Academy of Sciences, with 24,740 endemic plants, accounting for 73.56% (Table 2).

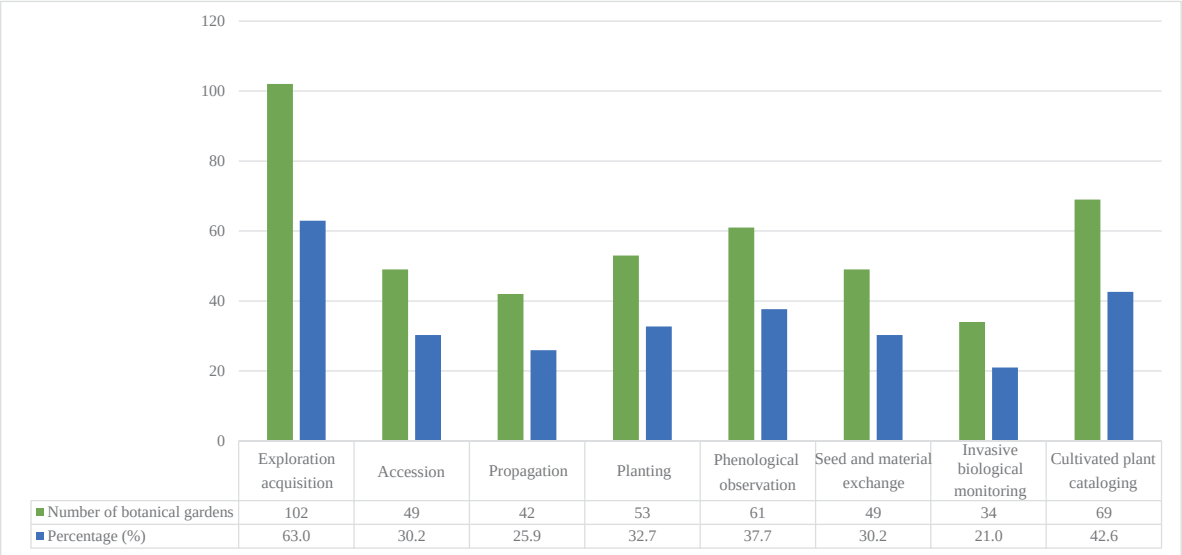
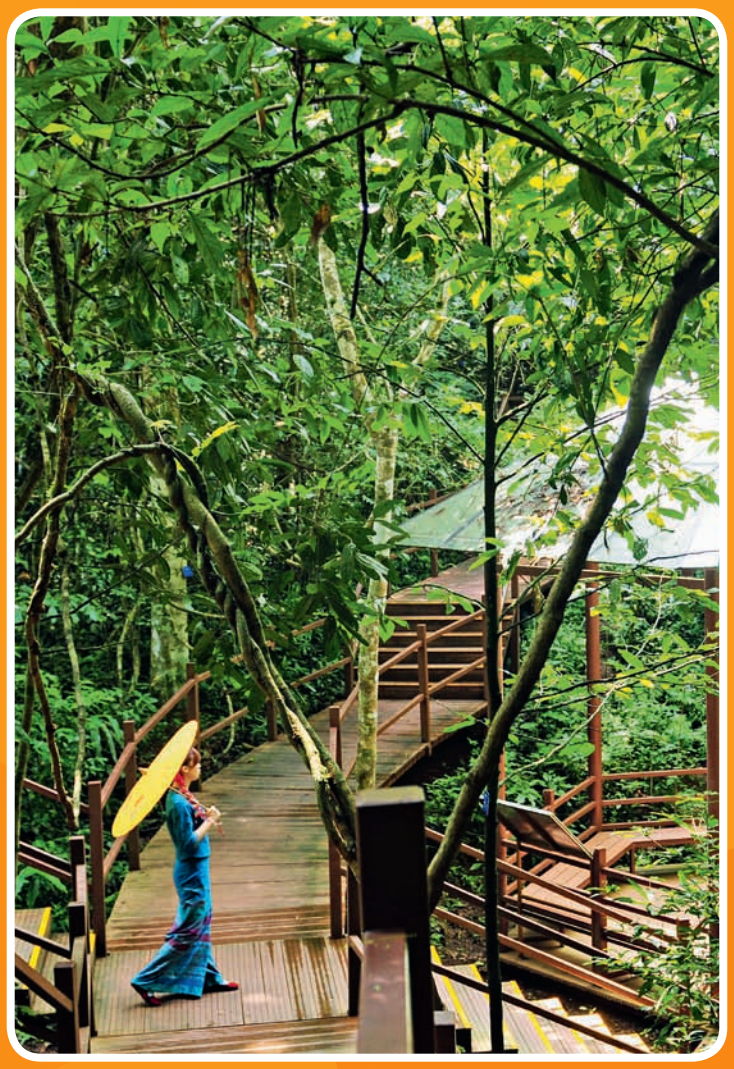


Figure 5 Statistics of acquisition and *ex situ* management in Chinese botanical gardens

Table 5 Comparative analysis of living collections for top 50 and top 11 botanical gardens of CAS and CUBG

	161 botanical gardens	CAS gardens	CUBG member BGs	The top 50 gardens	The top 11 gardens
Accessions	387,749	303,450/78.26	374,420/96.56	387,749/100	297,364/76.69
Species	250,829	77,933/31.07	155,710/62.08	142,796/56.93	70,271/28.02
Taxa	316,316	79,337/25.08	83,646/26.44	161,717/51.13	74,337/23.50
Specialized living collection gardens	1,195	262/21.92	737/61.67	636/53.22	209/17.49
Nationally and locally endemic plants	33,634	24,740/73.56	8,173/24.30	8,122/24.15	6,364/18.92
Rare and endangered plants	10,556	4,228/40.05	5,288/50.09	4,884/46.27	2,761/26.16
Medicinal plants	33,097	3,942/11.91	18,509/55.92	17,583/53.13	4,425/13.37
Trees	2,211,063	405,705/18.35	1,689,603/76.42	1,681,440/76.05	176,864/8.00
Unidentified accessions	40,980	11,974/29.22	27,367/66.78	31,446/76.73	22,943/55.99



Chapter 2

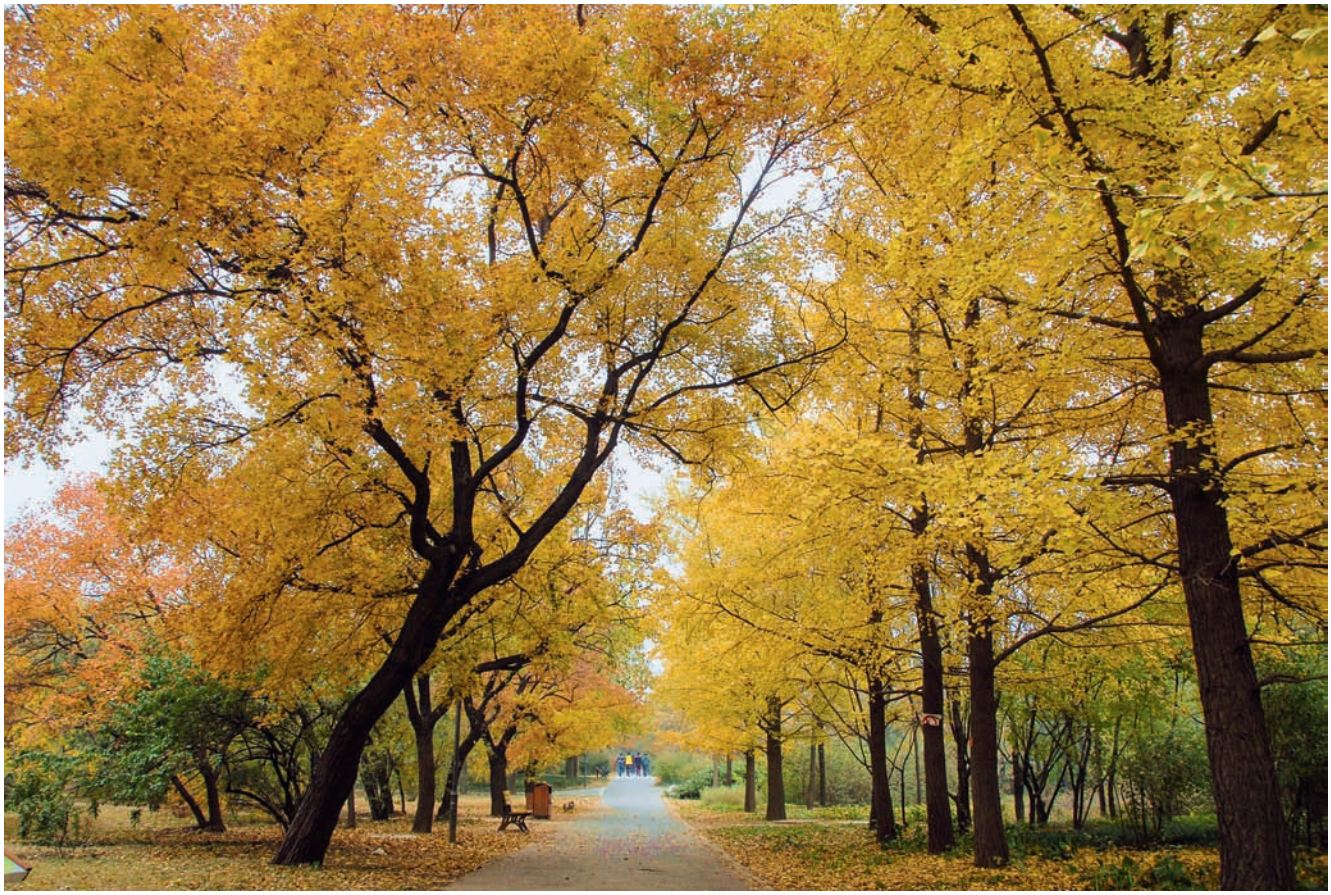
A Brief Introduction of Botanical Gardens of China

Beijing Botanical Garden of Institute of Botany, Chinese Academy of Sciences

Year Established: 1956

Brief Introduction:

The Beijing Botanical Garden, Institute of Botany, CAS, was prepared to construct in 1950, and founded in 1956 with the approval of the State Council. It is one of the first batches of botanical gardens to be constructed after the founding of the People's Republic of China. Located at the foot of Xiangshan, a famous scenic spot in Beijing, the planned area is 119 hm^2. The existing land area is 74 hm^2 with 20.7 hm^2 of the display area, 17.2 hm^2 of experimental field, 0.182 hm^2 of the exhibition greenhouse and 0.3 hm^2 of the experimental greenhouse. Focusing on collection, preservation and evaluation of the rare and endangered plants, endemic plants, economical plants, ornamental plants and environmentally-repairing plants, Beijing Botanical Garden, Institute of Botany, CAS, mainly collects and preserves the plants of the temperate zones in northern China and their ecologically similar areas, the Hengduan Mountains and the eastern Himalayas, introduces and domesticates the important foreign plant resource, and explores and utilizes the resource plants. This botanical garden is positioned as a reserve of national strategic plant resources, a research base for *ex situ* conservation and sustainable use of plant diversity in northern China, and a national science education base. The main tasks and functions are to carry out *ex situ* conservation and biodiversity research of wild plant resources in the temperate zone and its ecological environment in northern China, to explore plant resources, to summarize the theory and technical methods of plant introduction and domestication, and to use plant ecology and garden aesthetics to configure and display plants. It is an



organization that is open to the public and serves the public, integrating plant scientific research, *ex situ* conservation, scientific popularization, and personnel training.

This botanical garden is equipped with the Key Laboratory of Plants Resources and Huaxi Sub-alpine Botanical Garden. In total, 145,000 populations of 6,544 taxa, 3,475 species are cultivated, including ca. 800 species of arbor and shrubs, more than 2,000 species of tropical and subtropical plants, nearly 500 species (including varieties) of flowers, more than 400 species of fruit trees, aromatics, oilseeds, Chinese herbal medicines and aquatic plants, etc. There are 82 species of rare and endangered plants and 308 species endemic to China or endemic to the local region. The seed specimen collection contains more than 75,000 seed specimens and more than 22,500 species. Sixteen specialized living collection gardens have been constructed, and they are the Arboretum, the Bulbs and Tuberous Rooted Plants Garden, the Rose Garden, the Magnolia and Peony Garden, the Herb Garden, the Lagerstroemia Garden, the Wild Fruit Tree Resources Section, the Environmentally-Protecting Plants Section, the Aquatic Plants Section, the Rare and Endangered Plant Section, and the Tropical and Subtropical Plant Exhibition Greenhouse, etc. Among them, there are 338 taxa of 45 species of Fagaceae, 360 taxa of Rosaceae, 120 taxa of 27 species of *Syringa*, and 210 taxa of 42 species of aquatic and climbing plants with *Nymphaea*, *Victoria*, *Wisteria*, and *Celastrus orbiculatus* as representative plants, 97 species of gymnosperms with plants of *Taxus*, Pinaceae, Cupressaceae, and Taxodiaceae as representative plants, and 48 species of rare and endangered plants with *Tapiscia sinensis*, *Sinocalycanthus chinensis*, and

Liriodendron chinense as representative plants. Since the establishment of the garden, more than 1,993 papers have been published and more than 70 patents have been applied. Besides, invasive species management system and plant introduction and *ex situ* conservation management system, with a detailed record of plant acquisition, accession, planting, propagation, phenological record, and computerized record system, "Checklist of Cultivated Plants" and "Checklist of Seed Exchange", are all documented. From 2010 to 2015, 674 species of plants were exchanged. 320 new varieties were cultivated, 31 new varieties were authorized, and 190 landscape and ornamental plants were also promoted.

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Number of Accessions: 145,000
Number of Species: 3,475
Number of Taxa: 6,544