

上海辰山植物园植物收集的现状和展望*

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摘要: 上海辰山植物园于 2005 年开始筹建, 与此同时启动了植物收集工作。本文就辰山植物园基本情况、植物收集中长期规划、进展及技术策略进行了论述。活植物收集和标本收集是辰山植物园植物收集工作的两个方面。活植物收集包括以华东植物区系植物为主的物种收集和以上海适生的观赏植物为主的园艺品种收集, 如鸢尾属、绣球属、茱萸属、锦带属和绣线菊属的观赏园艺品种。截止到 2010 年, 辰山植物园共收集了 9 000 种和园艺品种。其中, 华东植物区系物种有 1 700 种, 来自世界范围专业苗圃的园艺品种有 2 800 个, 另有 4 500 种和品种是种植于温室的热带和亚热带植物。目前共收集了近 10 000 份标本, 多数为研究和活植物收集的凭证标本, 全部存放于上海辰山植物园标本馆 (CSH)。

关键词: 辰山植物园; 植物收集; 总体规划; 现状; 展望

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Today and Tomorrow of Plant Collection in Chenshan Botanical Garden, Shanghai

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Abstract: The plant collection of Chenshan Botanical Garden (CSBG) was started in 2005, when construction of the Garden began. This paper discussed the background of Chenshan Botanical Garden together with general planning and progress of the plant collection and the plant record system. Two collections are noted, the living collection and specimen collection. The former includes species collection and cultivars. The aim of the species collection is to collect plants of species which are distributed in China, especially ones in East China. The cultivar collection reflects interests with ornamental plants which are suitable to be planted in Shanghai and world-renowned such as Iris, Hydrangeas, Viburnums, Weigelas and Spiraeas. By 2010, there are more than 9 000 taxa of living plants in the collection, including 1 700 species (+infraspecific taxa) from local East China; 2 800 cultivars from nurseries around the world; 4 500 species and cultivars of tropical and subtropical plants from South China and other tropical areas of Asia. The Herbarium of Chenshan Botanical Garden (CSH) has collected 10 000 specimens for research and reference for the living plants collection.

Key words: Chenshan Botanical Garden; Plant collection; General planning; Status; Prospects

1 Introduction

Plant biodiversity is the spirit of a botanical gar-

den, with the living plant collection providing a guarantee to keep and improve the plant biodiversity

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of the botanical garden (He Shan-an, 2005). According to this principle, Chenshan Botanical Garden (CSBG) regards developing the plant collection as one of the most important tasks it faces currently and in future.

According to the brief history of botanical gardens in the world, botanical gardens in Shanghai need to have more development. As a new botanical garden, CSBG will be a comprehensive Botanical Garden with plant science research, education and amusement. The garden will attract the public with good garden design (Zhang *et al.*, 2010).

Plant collection in CSBG started in 2005, when the construction of the Garden began. Two collections are noted, the living collection and specimen collection. The former includes species collection and cultivars. The aim of the species collection is to collect plants of species which are distributed in China, especially ones in East China. The cultivar collection reflects interests with ornamental plants which are suitable to be planted in Shanghai and world-renowned such as Iris, Hydrangeas, Viburnums, Weigelas and Spiraeas.

2 General situation of Chenshan Botanical Garden

2.1 Background of project

Shanghai is a modern metropolitan with high reputation and standing in the world. The botanical garden is so important for plant conservation and research and it is considered as one of the landmarks of city infrastructure and culture. Shanghai Chenshan Botanical Garden is a joint effort between the municipal government of Shanghai, the Chinese Academy of Sciences and the State Forestry Administration of China. Starting from 2005, the project of Botanical Garden began in Songjiang District of Shanghai by the 2010 EXPO.

2.2 Location and climate

Chenshan Botanical Garden is located in the Chenshan (Hill Chen) in Song Jiang District of Shanghai, 20 km away from center of Shanghai. Chenshan

is in the northern subtropic monsoon moist climatic region. The four seasons are distinct. The annual mean temperature is 15.6°C. The non-frost period is 230 days. The annual mean sunshine is 1 817 hour. The annual rainfall is 1 213 mm and the annual land transpiration is 754.6 mm. The maximum temperature is 37.6°C and the lowest temperature is -8.9°C.

2.3 Missions and targets

The target of Chenshan Botanic Garden is to be one of the world-class botanic gardens in the near future, renowned for conservation, research, and education. Chenshan Botanical Garden is aiming to collect, conserve plants mainly from East China, to create a landscape with the style of East China, and to provide plant education to the public. With both scientific and horticultural expectations, the botanical garden will be active in biological research, biodiversity conservation, public education, and exhibition, making contributions to the sustainable development of the city and the country. Plant collection is one of the most important missions of this botanical garden.

2.4 Future research

East Asia is rich in plant species, and possesses a lot of endemic plants. An extensive collection of these plants will be a distinguishing feature of the Botanical Garden. Another feature of the Botanical Garden will be the emphasis on the relationship between human beings, water resources and plants.

With support from the Chinese Academy of Sciences, the Botanical Garden owns its CAS Research Center for scientific studies. Research in the followings areas is being planned for the CAS Research Center of the Botanical Garden: I Horticulture and biotechnology; II Biodiversity and evolutionary genomics; III Environmental ecology; IV Plant molecular physiology; V Plant protection.

3 General planning for plants collection

General planning for plant collection of Chenshan Botanical Garden was undertaken in 2010. Ac-

cording to the general planning, 20 000 taxa of living plants and 300 000 specimens will be collected by 2050.

Among the living plants, 12 500 taxa are species, and 7 500 are cultivars. At least 60% of species will be collected from field populations, and no more than 40% of ones from botanical gardens and nurseries. That means more than 7 000 plants of species will have completed field records. The main areas of origin will be East China (Shanghai, Zhoushan Islands, East China mountains), the middle of China, Southwest China, Northwest China, Caucasus in Russia and East Africa. In order to turn the planning into reality, national and international co-operation is very important.

4 Current living plants collections

4.1 Progress of living plants collections

Till 2010, there are more than 9 000 taxa of living plants has been collected, including 1 700 species (+infraspecific taxa) from local East China, 2 800 cultivars from nurseries all over the world, and 4 500 species and cultivars of tropical and subtropical plants from South China and other tropical area of Asia. (Tian *et al.*, 2010).

4.2 Collections from natural populations

Collections from natural populations are the most important task for CSBG's collection. By 2010, more than 2 000 species have been collected in the past five years. Most of these collections were from Flora East China (FEC), which includes Shanghai, Zhejiang, Jiangxi, south of Jiangsu, south of Anhui, east and middle of Hubei, south-east of Hunan, South edge area of Henan, north edge of Fujian. There are about 4 300 species of seed plants in these areas (Liu *et al.*, 1995), and 40% of these plants were collected in Chenshan Botanical Garden. Most of these collections were planted in the theme garden of Flora East China Garden (Tian *et al.*, 2010).

Among all of the collections from natural populations, the top ten families are Rosaceae, Legu-

minosae, Magnoliaceae, Lauraceae, Oleaceae, Fagaceae, Liliaceae, Verbenaceae, Caprifoliaceae and Myrinaceae. Table 1 indicates that more than 50% of total species in five families, which are Labiatae, Caprifoliaceae, Magnoliaceae Oleaceae and Fagaceae, were collected in Chenshan Botanical Garden, while the other five families account for less than half.

Collections of rare and endangered plants, distributed in East China were paid particular attention by collecting team in Chenshan Botanical Garden.

Table 1 Top ten families of CSBG's collections
from Flora East China

Families	Number of collections	Total in FEC *	Percents of total in FEC * (%)
Rosaceae	96	208	46.2
Labiatae	89	158	56.3
Leguminosae	58	197	29.4
Caprifoliaceae	49	69	71.0
Magnoliaceae	32	45	71.1
Fagaceae	31	58	53.4
Liliaceae	29	105	27.6
Lauraceae	27	72	37.5
Verbenaceae	21	47	44.7
Oleaceae	19	34	55.9

* FEC: Flora East China

Much work remains to be carried out to evaluate the status of the world's plants, it is clear that between 60 000 to 100 000 plant species are threatened worldwide (CBD, BGCI, 2002). As a natural floristic region of Sino-Japan forestry subkingdom, Holarctic kingdom, East China has 407 national rare and endangered species (+infraspecific taxa) of 87 families, 237 genera. With age-old origin, East China not only has abundant relict and ancient species, but also has many endemic genera and species, and about 66.09% species are endemic to China. More than 100 species of rare or endangered plants were collected from East China in Chenshan Botanical Garden. Some of these species were collected on population level. For example, we collected all of the populations of *Neolitsea sericea* from the

Zhoushan islands in East China Sea and determined the genetic diversity of all the populations in the past several years.

4.3 Cultivar collections from nurseries in Europe and America

As one of the important parts of collections in Chenshan Botanical Garden, cultivar collection started from 2006. Till 2010, about 2800 cultivars were collected from nurseries all over the world such as Germany, Holland, Italy and the United States of America. Most of these cultivars are famous ornamental plants. For instance, many cultivars of Rosa, Iris, herbaceous peony and Hydrangea were collected. Cultivar collection was aimed to establish and improve the theme gardens in Chenshan Botanical Garden.

To display specific plants, theme gardens play a very important role in botanical gardens. In order to establish the theme garden system of Chenshan Botanical Garden, 69 famous botanical gardens were examined to study the characteristics of theme gardens. This showed that there are 50 different theme gardens in these botanical gardens. Some theme gardens such as rose garden, rock garden, water garden, arboretum garden, oriental garden, herb garden, ecology garden appear in more than 40% of botanical gardens. As the reference, combining with local conditions and to differentiate from present garden in Shanghai, 30 theme gardens are considered in Chenshan Botanical Garden, Shanghai (Hu, 2006). So far 26 theme gardens have been constructed according to the general planning. Among of them, Rose garden, Peonia garden, Iris garden, Magnolia garden, Osmanthus garden, ornamental shrubs garden and ornamental herbs garden are regarded as the important gardens in Chenshan Botanical Garden.

The Iris garden is one of most important theme gardens in Chenshan Botanical Garden. A specific team was established for this in 2007. The main work of the team is to collect cultivars of Iris and conduct conservation research for some local species

in China such as *Iris ensata* and *Iris bullyana* (Xiao *et al.*, 2008, 2010). Over 650 cultivars have been collected in the past few years. Wetland Irises including Series Sibericae, Laevigatae and Hexagonae have been a focus of attention. More than 350 cultivars of them grow well in the Iris garden.

Table 2 Important theme gardens in CSBG and their number of cultivar collections

Theme garden	Area (m ²)	Number of collections	Number of cultivars in garden
Shrub garden	3 328	750	630
Iris garden	2 129	650	350
Rose garden	4 651	570	300
Herb garden	921	260	190
Peony garden	2 470	95	78
Magnolia garden	9 500	67	32
Osmanthus garden	6 585	53	45

The Osmanthus Garden is another specific theme garden in Chenshan Botanical Garden. This genus has great economic value. The main distribution of Osmanthus is in China. The plants of species in this genus have beautiful and fragrant flowers (Yang *et al.*, 2010). 53 cultivars of Osmanthus have been collected, while 47 of them are cultivars of *Osmanthus fragrans*, the others are of *Osmanthus heterophyllum*.

4.4 Tropical and subtropical collections in conservatory

The conservatory is one of the most important parts of the overall construction of Chenshan Botanical Garden. Three units of green house cover more than 10 000 m². The construction of the conservatory started from 2008 and will be finished by the end of 2010. The themes of the conservatory include tropical forests, ferns valley, succulent plants area, Bromeliaceae area. There are about 4 500 taxa of tropical and subtropical plants in the collections now, including more than 1 000 taxa of Bromeliaceae, 800 taxa of Cactaceae, 350 species of ferns, 120 species of tropical and subtropical trees. Almost all of succulents and plants of Bromeliaceae were acquired from Shanghai Botanical Garden.

5 Methods of collection in Chenshan Botanical Garden

Three methods of collection have been employed to acquire living plants in the past five years; collecting seeds in the field, introducing from botanical gardens and buying from nurseries. Collecting seeds in the field was used to collect and conserve the plants of species distributed in Flora East China and other areas. Most of the cultivars and some species were collected through the other two methods. And almost all of the plants in conservatory were collected by introducing from botanical gardens.

Table 3 indicates that about 16.7% of total collections were collected through the method of collecting seeds in field, 41.1% ones through introducing from botanical gardens, and the other 53.3% ones from by buying from nurseries. The latter two methods are very important for a new botanical garden like CSBG, through which more plants can be collected in a short time. But collecting seeds is the best method for the collections of species in the field, because the records of the information such as location, habit and vegetable and so on are needed.

Table 3 Collection methods of living plants and their numbers of taxa

Methods of collection	Number of species	Number of cultivars	Number of all taxa	Percents of total (%)
Collecting seeds in field	1 500	0	1 500	16.7
Introducing from BGs *	200	3 500	3 700	41.1
Buying from nurseries	300	4 500	4 800	53.3

* BGs: botanical gardens

6 Completed records for plant collections

One of the most important tasks for a botanical garden is to build a collection of plants, especially to collect field individuals with well-documented records for *ex situ* conservation. *Ex situ* conservation is considered to be one of the most important forms of biodiversity conservation (Zhao, 2009). Collection

records of Chenshan Botanical Garden include field records, phenophase records, seed information, sowing records, transplanting records, disease records, cited specimen and photographs. There are different records for different type of collections (Table 4). Location, altitude, habitat, soil type, vegetables, collectors, date, characters of plant and its name are all necessary to record for a field collection.

Table 4 Different records for different types of collections

Records type	Field seed collection	Field individuals collection	Cultivars collection
Field records	●	●	○
Phenophase records	●	●	●
Seed information	●	○	○
Sowing records	●	○	○
Transplanting records	●	●	●
Disease records	●	●	●
Cited specimen	●	●	○
Photographs	●	●	●
Scientific name	●	●	○
Horticulture name	○	○	●

● yes; ○ no

7 Recent actives for collection

The living collections of Chenshan Botanical Garden will focus on plants from East China, islands in East China Sea, East Africa, Caucasus and so on. Cultivars are acquired from nurseries in Germany, Holland, Italy, Canada, Kenya and other countries. In addition to research and field collecting programs in some areas of China, some international interesting cooperation in the Caucasus and Kenya collection, will have far-reaching influence on our future collections.

As the team of collection in Chenshan Botanical Garden, we appreciate anyone who has given us much help for our collection, such as Hamburg Botanical Garden (Germany), Kew Garden (England), Shanghai Botanical Garden (China), Wuhan Botanical Garden (China) and Beijing Botanical Garden (China). We will be very grateful to anyone with whom we will take part in the co-operative activities.

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