Journal of Botanic Gardens Conservation International

BGjournal

Volume 3 • Number 2 • July 2006

Special issue: the botanic gardens of East Asia

BGCI
Plants for the Planet



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BGjournal is published by **Botanic Gardens Conservation International (BGCI)**. It is published twice a year and is sent to all BGCI members. Membership is open to all interested individuals, institutions and organisations that support the aims of BGCI (see page 32 for Membership application form)

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BGCI is a worldwide membership organization established in 1987. Its mission is to mobilise botanic gardens and engage partners in securing plant diversity for the well-being of people and the planet. BGCI is an independent organization registered in the United Kingdom as a charity (Charity Reg No 1098834) and a company limited by guarantee, No 4673175. BGCI is a tax-exempt (501(c)(3) non-profit organization in the USA and in Russia.

BGjournal replaces *BGCNews* and is published twice a year. *BGjournal* has been given a new name as the news section of *BGCNews* and *Roots* (Botanic Gardens Conservation International Education Review) is now contained in *Cuttings* which is published quarterly. There are 31 issues of *BGCNews* published twice yearly from 1987-2003.

Contents



Editorial

On behalf of the botanic garden community of East Asia, we are pleased to introduce this special issue of BGCI's BGjournal that focuses on the botanic gardens of East Asia and some of their work in education and plant conservation. The production of this issue has been supported by the Mitsubishi Corporation in Japan as a part of their assistance to develop the networking of botanic gardens in the East Asia region.

Unlike all previous issues of BGJournal, which were only published in English, the July 2006 issue has also been produced in Chinese, Korean, Japanese and Russian and will be distributed to all of the botanic gardens within the East Asia region. By doing so, we are keen to not only make the global botanic gardens community more aware of East Asia, but also to encourage networking within the region. We also hope that the East Asia issue of the BGjournal will be useful as a part of the development of the East Asia Botanic Gardens Network at its first meeting. This first meeting is to be held at the Kunming Botanical Gardens in August 2006.

Throughout the East Asia region there are now over 250 botanic gardens and the number is increasing. It is a blend of several major institutions and many that are small with few staff and limited funds. Although the scale of many gardens is small, together they display a diverse collection of plants; assist conservation through the cultivation of endangered plants, and; shoulder most of the education activities that are related to the diversity and function of plants, the relationship between them and people and their conservation.

To support the activities of botanic gardens in Japan, China and Korea national botanic garden networks have been established. Since their establishment, going back to 1965 in Japan, these networks have contributed to the activities of their member gardens, including conservation, environmental education, horticulture and recreation.

However, with the speed of environmental change in East Asia, the reduction of plant diversity is a reality. To cope with such change, it is recognized that as well as strengthening the domestic botanic gardens networks, a network in the East Asia region, working together with BGCI, should be explored. It is felt that if the botanic gardens of this area can make contact with each other through the network, we can take effective action against the crisis facing the region's plant diversity.

As a part of this, all of the botanic gardens in the East Asia region are encouraged to not only interact with botanic gardens in their immediate area but also to look for any opportunities to work with other botanic gardens throughout Asia.

Over the past four years BGCI has been conducting the Investing in Nature programme throughout the Asia region. Supported by HSBC, it is has greatly helped to assist the botanic gardens of the region expand their efforts in conservation and education. The programme has not only enabled BGCI to fund a number of projects within individual botanic gardens, but also assist in the training of a large number staff in a wide range of topics. It is the intention of BGCI and the botanic gardens networks of East Asia to continue the good work that has already started. Because of this, we would encourage all of the botanic gardens of East Asia to join BGCI, take advantage of the resources and programmes it offers and, as importantly, ensure that the significance of the Asia region is fully recognized throughout the world.

Prof. Hongwen Huang, Chairman, Botanical Garden Working Committee of Chinese Academy of Sciences

Prof. Jung Oh Hyun, President, Korean Association of Botanic Gardens and Arboreta

Mark Richardson, Director, Asia and Middle East Programmes, BGCI

Prof. Mitsuo Suzuki, President, Japan Association of Botanic Gardens

Authors: Hongwen Huang
and Ziyuan Duan

Thoughts on scientific research in Chinese botanic gardens at the beginning of the 21st century

Above: Bamboo collection at Wuhan Botanical Garden, Hubei (Photo: BGCI)

In the 21st century there are major challenges to meet the demand for plant resources sustainably. Botanic gardens play an increasingly important role in plant conservation and their sustainable development (Wyse Jackson & Sutherland, 2000).

The current status of wild plant resources and plant conservation in Chinese botanic gardens

China has over 30,000 species of higher plants, representing 10% of the world total; the richest plant diversity, after Brazil and Colombia. However, in the past 30 years, rapid economic development and population growth has damaged the ecological environment and reduced plant diversity and research into conservation and development is falling behind. For instance native species are endangered, crop wild relatives are becoming extinct, plant genetic diversity is being lost (China had 10,000 wheat cultivars and varieties in 1949, but only 1,000 were in cultivation in 1970s (FAO, 1998), research and development on economic crops is weak and alien species threaten indigenous plants and associated ecosystems.

The Chinese Academy of Sciences (CAS) regards botanic gardens as an essential resource for the development and utilization of plants and has 14 botanic gardens under their management. By 2004, CAS botanic gardens had introduced and conserved about 20,000 higher plant species, which is 60% of the China Floristic Region and provides a resource pool for sustaining economic development in China. CAS has also set up 90 specialized gardens, which form a solid foundation for botanic research, development, utilization and conservation of plant resources, as well as public education in China. Since, 2004, they have had over 100 articles published in science journals (e.g. *Science, Nature, Conservation Biology and Molecular Ecology*), three times higher than that in 2001. These include the discovery of two new pollination mechanisms. These botanic gardens have applied for over 100 patents and have had 50 approved and have cultivated and propagated nearly 20 new cultivars.

Thoughts on scientific research in Chinese botanic gardens in the early 21st century

According to Wagner (1972), "A botanic garden without scientific research is just a park. A botanic garden with scientific research plays an important role in social development." Further, the life sciences are in an era of molecular biology and so research in botanic gardens faces a great opportunity as well as a grave challenge, for broadly-based botanical research.

1 Research direction and targets

- The focus should shift from plant collection and conservation to the identification, development and sustainable use of resources and include the selection and evaluation for improved quantity and quality.
- Resource information should be shared fully within China and conditionally across nations.
- A conservation network should be set up that covers at least 80% of all the native plants in China.
- Chinese botanic gardens should take advantage of their accumulated research and rich plant diversity and take a leading role in the East Asia Botanic Garden Network.

2 Strengthen capacity and scientific research

Development of specialized gardens and related scientific research

Botanic gardens should support the development of specialized gardens for endemic and native plants especially those of economic value to enhance China's development. This will build on current plant collections. For instance gardens for medicinal plants, bio-fuels (taxa which are rich in carbon-hydrogen bonds), amenity plants, fruits and vegetables and plants which can be used for habitat restoration and environmental protection.

Research and development centres for research into molecular biology and comparative biotechnology
The plant resources held by botanic gardens provide valuable materials and are important centres for research into comparative functional genomics, phytochemistry and proteomics as well as research into model genes and model plant species. This will support China's current life science and biotechnology research.

Development of information technology
An information management system for a National Botanic Garden System of China should be set up to improve resource management within the network, improve information retrieval, research and development and information exchange, and raise the level of popular science education of the general public and mass media.

3 Research topics and direction
Certain core research studies in China are essential for species recovery plans such as population genetics and breeding systems and the theory and practices of habitat restoration to conserve native plant species in situ. Research into living plant collections and seed banks are strategically important to conserve plant species and genetic samples.

There is also a need to set up a chemo-resource bank for medicinal plants and a DNA bank for rare, endangered and endemic plants with an associated data information platform. Another necessary research topic is the biosafety of plant resources globally.

4 China's *National general survey of plant resources for the century*
A National general survey of plant resources for the century is an urgent task to provide a solid scientific basis for the formulation of China's social and economic development strategies.

Left: Medicinal plant collection at Xishuangbanna Tropical Medicinal Garden, Yunnan (Photo: BGCI)

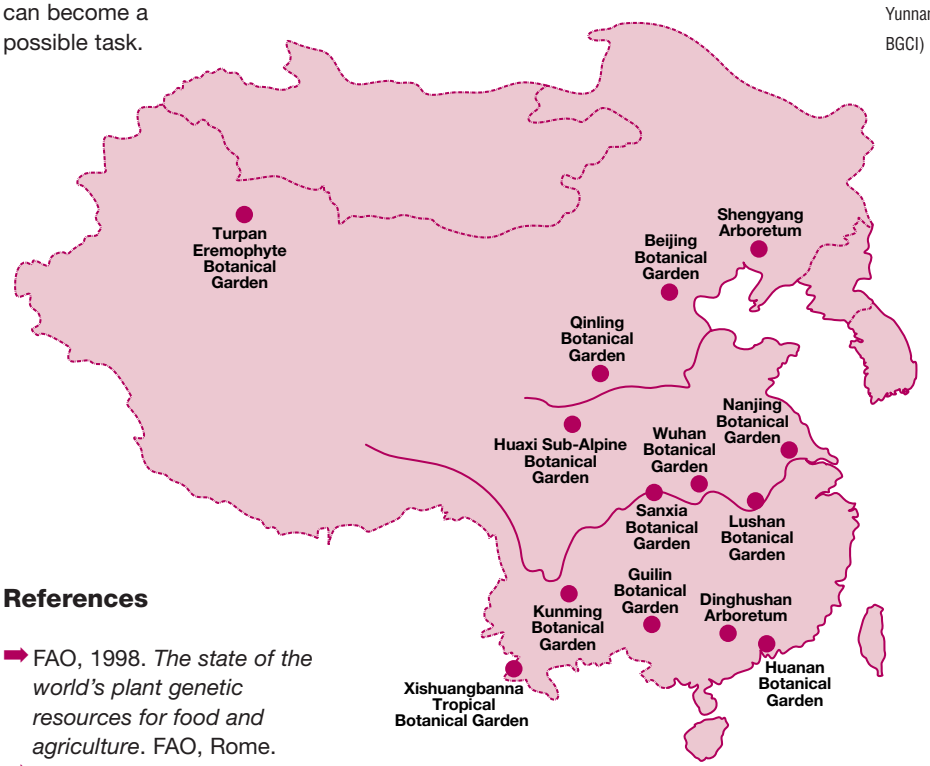
The content and objectives should be to: a) research and identify the status of plant resources in China to produce a *Report on the current status of China's plant resources with an on-going Report monitoring the dynamic changes of China's plant resources* every 3-5 years, b) enrich the collections in China's national herbaria, c) encourage experts in plant taxonomy and horticulture, and d) provide facilities for the new editions of Floras available in English and Chinese.

Conclusion

Through defining the scope of research for Chinese botanic gardens as well as strengthening both the network and capacity for botanic gardens in China, the safety and sustainable use of plant resources in China will be ensured and can become a possible task.

Above: View of Kunming Botanical Garden, Yunnan (Photo: BGCI)

Distribution of the 14 botanic gardens under the management of the Chinese Academy of Sciences



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BGCI supports collaboration between botanic gardens: the environment and artistic photo exhibition, *Sound of Nature* at Xishuangbanna Tropical Botanic Garden

With sponsorship from a 2004/05 BGCI Travel Scholarship, two young technological staff members of the Xishuangbanna Tropical Botanic Garden (XTBG), China, Duan Qi-wu and Yan Tao, undertook three-weeks training from 27 February to 20 March 2005 at Hong Kong's Kadoorie Farm and Botanic Garden (KFBG).

During the study period, KFBG organized artistic activities to turn the theories of scientific education into practice, thus increasing the public's awareness of environmental conservation. Duan Qi-wu of XTBG actively maintained a close relationship with KFBG's Education Department and the Xishuangbanna Prefecture Commission's Publicity Department in the preparation of an activity on general scientific education on the theme of environment and the arts. The environment and artistic photo exhibition, *Sound of Nature* opened on 1 November 2005, and was well received by many different sectors.

1. Environment and artistic photo exhibition, *Sound of Nature*

1.1 Exhibition objectives

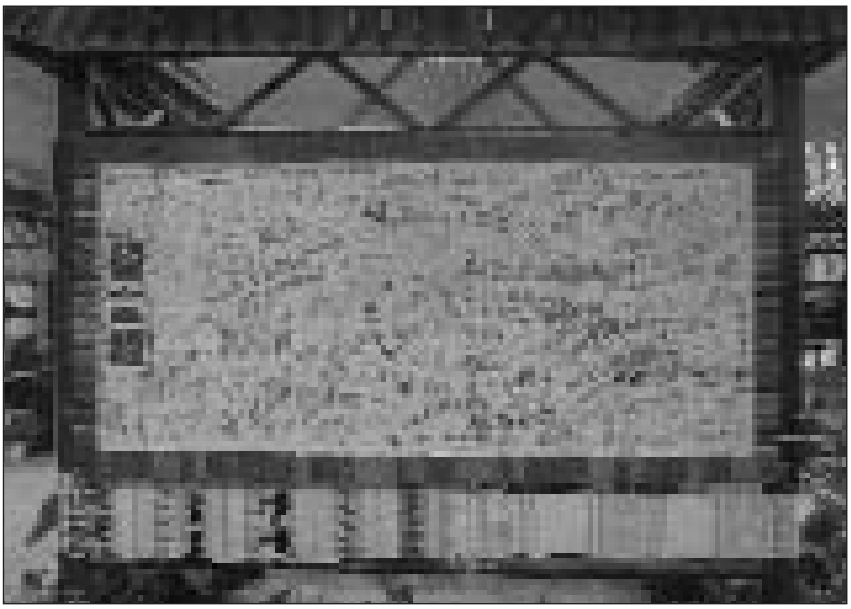
The display of artist's creations truly shows the beauty and wonders of all life forms in nature. The exhibition helps the audience to appreciate the natural environment, ethnicity, cultures and biological and cultural diversity in terms of visual effects and content.

1.2 Photo composition

The art pieces exhibited included photos of KFBG's two art festivals, namely. "Dream Garden" (2003/04) and "Garden's Whisper" (2004/05). Photos of tropical rainforest and tribal forest cultures are also displayed.

1.3 Display format

Natural materials were used, such as bamboo, wood, rattan, plant seeds, pebbles and various plant species. While the photo exhibition is the main focus, local characteristics, tribal and rainforest culture are integrated to show the beauty of nature. Planning and design staff cleverly exhibited landscaped gardens, decorated arts and behavioural arts. With variations in the size, shape, aspect ratio, and height, the displays were dynamic and interactive. Some panels also had traditional bamboo buckets and sieves. These exhibits also demonstrated local Xishuangbanna characteristics and cultural background of the ethnic



Right: Comments by visitors

Left: Wylie Chu (Centre - Education Officer, Community Projects, Education Department, Hong Kong Kadoorie Farm and Botanic Garden) giving a guided tour to students

Far left: Primary and secondary school students visiting the exhibition

minorities. The fun in nature (sound, color, taste and shape) showed the seamless harmony between the environment and nature. The buildings and the shade garden (for shade tolerant plants) were arranged well so that the two could complement each other. It is an exhibition venue high in both exhibition and landscape value.

1.4 Media coverage

News of the exhibition was posted on the websites of the Chinese Academy of Sciences and Xishuangbanna Tropical Botanic Garden. It was covered by the Xishuangbanna and Mengla televison stations and newspaper, the Xishuangbanna Daily.

1.5 Results

It was estimated that the exhibition attracted up to 50,000 visitors. The exhibition called for people to care and love their environment, protect nature, appreciate their traditional cultures, and protect biological and cultural diversity.

We adopted the Behavioral Observation Method, Questionnaire Method, and Interview Method to conduct systematic survey studies on visitors and project participants (including organizers) in different stages.

Staff from XTBG and KFBG understood each other better. Also, the process of organizing the exhibition reinforced the cooperation and exchange among different professionals in the two botanic gardens.

1.6 Further impacts

KFBG and XTBG agreed on several issues, including: the exchange and visits of our scientific education department members, research projects on general scientific education theories for botanic gardens, collaboration on environment and art education, more cooperation on scientific education networking, and plant conservation research projects. During their visit, for the opening of the exhibition (1st November, 2005) KFBG's Education Department gave a training session to over 80 scientific education interpreters of XTBG, so that they could be better prepared for the exhibition.

2. Further collaboration projects

2.1 Collaboration projects with KFBG

- Exchange and visits of scientific education staff to enhance the work of general scientific education for both parties
- Research and evaluation of general scientific education methods
- Collaboration in environment and art education: Hopefully XTBG will organize a scientific education exhibition on rainforest tradition and culture at KFBG
- Collaboration in scientific education networking, e.g. projects related to geographic information system and long-distance video-recording
- Collaboration in plant conservation research aiming at improving landscaped gardens and having more plant species
- Student exchange on a regular basis

2.2 Collaboration projects with other organizations

- Paper-making exhibition by minorities in Yunnan Province, to promote the traditional paper-making
- Formation of the Xishuangbanna Prefecture Museums Association, which will bring these museums together: Tropical Rainforest and Ethnic Forest Culture Museum, Xishuangbanna Natural History Museum, Mengle Museum, Ji-nuo TribalMuseum, Bu-lang Tribal Ecology and Culture Museum, and Mengla County Ethnic Museum

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The management of living collections in Beijing Botanical Garden (North)

Right: Greenhouse at Beijing Botanical Garden (North) (Photo: Beijing Botanical Garden (North)

Beijing Botanical Garden was founded in 1956. The State Council authorized the Chinese Academy of Sciences and the Beijing Municipality to set up a new botanic garden of state level in a west suburb of Beijing. Subsequently, it was divided into two gardens; the north garden was supported by the Beijing Municipality, while the south garden was annexed to the Chinese Academy of Sciences.

The mission statement of Beijing Botanical Garden (North) is to: "promote the knowledge of plants to the public, conduct research, and create a beautiful environment for recreation through the collection and conservation of plant diversity and the display of plants in attractive settings".

1. Objectives of Beijing Botanical Garden

The Objectives of Beijing Botanical Gardens are:

1. Conservation: to collect a diverse and well-documented collection of living plants to be displayed in horticulturally attractive settings.
2. Education: to promote public awareness and knowledge of plants and the importance of their conservation.
3. Research: to pursue botanical and horticultural research programmes.
4. Recreation and tourism: to develop the landscape to a high standard to provide a place of recreation for local residents and a tourist attraction.

2. Management objectives

2.1 Conservation

- support *ex situ* conservation of plant diversity by collection, propagation and maintenance of taxa which are rare, threatened or endangered in the wild in accordance with recognized and national strategies.
- support *in situ* conservation of plant diversity through research and education programmes undertaken in the garden
- conserve cold hardy ornamental collections
- actively participate in the preparation of national strategies for biodiversity conservation and the sustainable use of plants
- establish a national collection of plants through cooperation with other botanic gardens

2.2 Research

- maintain accurate records of the plant collections for scientific reference
- trial species which are considered worthy of introduction into cultivation in Beijing
- breed new varieties of ornamental plants
- support scientific research in the garden as well as in other institutions by growing and displaying plants of scientific interest in the garden
- participate in cooperative research projects with universities or institutes

2.3 Education

- develop the gardens as an educational resource, ensuring information is accessible for all visitors and non-visitors (via internet and other multimedia) and to appeal to a broad range of interests and abilities
- develop the living plant collections as the primary educational resource and support their interpretation through a variety of means including plant labelling, a range of displays and visitor programmes

Left: Crab apple collection at Beijing Botanical Garden (North) (Photo:BGCI)

- ensure the collections support horticultural interests and environmental and other educational messages which are of relevance to the community
- enhance the diversity of collections to improve their educational value
- develop high quality educational facilities which will enhance access to information and services and provide suitable settings for education programmes

2.4 Recreation and tourism

- maintain, manage and develop the landscape to a high standard as the primary means of supporting recreation, thereby enhancing the gardens' value as a community and tourism resource
- manage and maintain the cultural heritage properly, thus attracting visitors
- encourage use by people of all ages including people from the city and visitors from other cities and countries
- ensure all features and facilities supporting recreation activities in the garden are integrated with the character of the landscape
- make use of the plants and launch activities to attract visitors

3 The present situation of living collections

3.1 Plant collections

The collection is composed of an outdoor and indoor collection. The outdoor collection includes the arboretum and the thematic gardens. The arboretum is divided into 4 parts and has been laid out systematically. The thematic collections are rose, paeony, ornamental peach, lilac, bamboo, Mei-flower (*Prunus mume*) and perennials.

The impressive conservatory attracts a great many visitors with a well-designed landscape and diverse plant species. The plants displayed include those from the tropical rainforest and desert, orchids, bromeliads, carnivorous plants, palms and many other plants. There are about 6,000 taxa.

3.2 Criteria for new plants collections

- conservation value – potential to support or promote conservation programmes
- educational value – relevance of themes to support or promote the garden's mission and objectives
- horticultural value – potential to attract visitors or potential to be planted in the city
- economic value
- cultural value

The following plants meet the collections criteria:

- wild taxa
  1. species of educational value – plants with special economic, or cultural values
  2. species of conservation value including:
     - rare and threatened species
     - genera in which China has a good number of species and which could become a National Collection
     - representative species of the local flora
- cultivated taxa
  - classic cultivars of Chinese origin
  - woody plants of ornamental value and potential for urban planting

3.3 Priorities for collections

Priorities should be given to the following categories of plants for inclusion in ex situ conservation

- taxa that are in immediate danger of extinction
- taxa that are of local economic importance
- taxa representing local ecotypes
- local flagship species or subspecies that will stimulate conservation awareness
- taxa that are of special scientific interest, such as narrow endemics or geographical relics

3.4 Sources of the plant materials

Plant material can be acquired from the following sources:

- direct collection from the wild
- exchange with other gardens
- purchase from nurseries
- donations from other sources

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Below: Crab apple collection at Beijing Botanical Garden (North) (Photo:BGCI)

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Achieving conservation and sustainability on different fronts – Hong Kong Kadoorie Farm and Botanic Garden

Kadoorie Farm and Botanic Garden (KFBG), located on the northern slopes of Tai Mo Shan, is a Hong Kong based non-profit corporation, with a tradition of agricultural aid dating back to the 1950s. In response to the rapid economic expansion and the decline in farming in Hong Kong, KFBG was realigned in the mid 1990s with the new direction to promote nature education, sustainable agriculture and the conservation of biodiversity in Hong Kong and the greater South China region. The mission is now "to increase the awareness of our relationship with the environment and bring about positive change in the world through conservation and education". We tackle this on a number of fronts.

Education in nature

We believe education is one of our most powerful conservation tools. With years of conservation effort, KFBG is now a lush hillside sheltering streams, woodlands, orchards and organic vegetable terraces. Not only is it a haven for local wildlife, but also a unique nature classroom providing over 20 educational displays featuring South China biodiversity, native wildlife conservation, organic farming and sustainable living. Every year, KFBG offers diverse educational opportunities, including school guided visits, nature-interpreter volunteer programmes, environmental arts programmes, wildlife habitat enhancement programmes, community gardening, an organic festival, organic farmers' markets… (the list goes on). We seek to provide visitors with a pleasant experience as well as striking and memorable encounters with our pristine natural environment, and thereby encourage people to appreciate and forge bonds with nature.

Right: Constructed wetland wastewater treatment system helps treat organic waste generated by our farm animals (Photo: KFBG)

Conservation in action

In adherence to our mission, KFBG has developed several teams to help protect biodiversity in the region, including departments of Flora and Fauna Conservation, and a China Programme.

Over the past years, KFBG has been actively conserving rare and endangered plants, ranging from ferns to orchids. We have initiated native tree nursery projects, both in Hong Kong and Guangdong, to encourage reforestation with native species. With close collaboration with Botanic Gardens Conservation International (BGCI), KFBG has actively conducted workshops and symposia to facilitate information exchange, develop and strengthen networks between botanic gardens nationally, regionally and internationally.

On the fauna conservation front, our Hong Kong work ranges from wildlife rescue to habitat conservation. In 1994, an outdoor butterfly garden was established by planting the hillside with butterfly food plants; today it is one of

Left: KFBG is a lush hillside sheltering streams, woodlands, orchards and organic vegetable terraces – in foreground below line (Photo: KFBG)

Below: Farm guided visits for local kids (Photo: KFBG)

the best sites to observe butterflies and moths in Hong Kong. With the concept of close-contact education in mind, KFBG has established a variety of educational displays including a raptor sanctuary, an insect house and an amphibian and reptile house. Through intimate contact with animals and plants and through on-site interpretation, we aim to evoke visitors' empathy and concern for wildlife; by linking these values to personal responsibility and the principles of sustainable living, we hope to help stem the tide of the modern extinction crisis.

The KFBG's conservation efforts are not limited to Hong Kong, but extend to the greater South China region. Since 1998, our China team has conducted a series of rapid biodiversity assessments in over 50 forest areas across Guangdong, Guangxi and Hainan. These have improved understanding of the distribution and status of many species, the conservation importance of their habitats and the urgent threats they face. In 2003, the China Programme expanded its focus: in addition to forest ecosystem conservation and protection of critically endangered species, the Programme promotes sustainable agriculture and sustainable living in the region. Our major engagements include conserving the Hainan Gibbon (the world's rarest primate) at Bawangling, enabling effective conservation of Hainan's last tropical forest strongholds, monitoring the devastating trade in wild animals, and channeling information to those who are able to influence conservation management and attitudes.

The way to sustainability

We believe sustainability is the key to a promising future. On the agriculture front, we seek to support sustainable food production systems that integrate human, environmental and economic considerations, and promote them in Hong Kong and the greater South China region. We publicise the consequences of human resource use – our Ecological Footprint – and transmit a vision to bring it within natural limits. Within KFBG's premises, we seek to develop institutional practices and apply resource conservation measures that reduce energy and resource consumption. Examples include a green procurement policy, the use of solar panels, a waste recycling treatment and green building design. In the long run, we aim to develop KFBG itself as a model for sustainable living.

Our world is changing at a great rate under ever-increasing population, rapid and senseless economic development and the resulting environmental degradation. For this decline to be reversed, conservation must expand from a minority concern to a deep and active commitment across society, founded on emotional, intellectual and spiritual connection with nature. Botanic gardens have traditionally been seen as pleasant landscapes, places to learn plant names, and sites of rare plant propagation. How can they make a greater contribution to sustainability? The question deserves more thought by botanists, conservationists, environmental educators, and visitors. With urgency, we need to expand the membership and positive impact of the team that cares.

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Conservation of an endemic plant, *Croton hancei* in the Hong Kong Special Administrative Region

Taxonomy

In 1997, staff of the Hong Kong Herbarium collected an unusual shrub of the family Euphorbiaceae from Tsing Yi Island, Hong Kong Special Administrative Region (HKSAR), China. After thorough examination by the experts from the South China Institute of Botany, the shrub was confirmed to be *Croton hancei* Benth. (Hong Kong Croton) which has been lost to botany for over hundred and fifty years.

C. hancei is a shrub about 2 m tall. The young branches and inflorescence are densely covered with stellate hairs which are absent in other parts of the plant. The oblong leaves are net-veined, with short petioles and serrulate margins, and usually densely crowded at the branch tips. The inflorescence is a raceme, each female flower has 3 styles and the upper part of each style is 2-lobed. The flowers appear in spring and the globular fruits set in summer.

This species was first discovered about 1850 by H. F. Hance on Hong Kong Island, but the specific location where he collected the type specimen is unknown British botanist George Bentham described it as a new species in *Flora Hongkongensis* in 1861, based on the specimen collected by Hance. Since then, the species had not been found until 1997 when it was rediscovered at a site on Tsing Yi Island. The species is considered endemic to Hong Kong as it is not known in any other locality.
The re-discovery of *C. hancei* contributes to the study of the Hong Kong flora and the genus Croton. For instance, Chang and Kiu (2003) examined the material from Tsing Yi Island and compared it with specimens from Guangxi which were identified earlier as *C. hancei*. Chang and Qiu noticed differences in the male and female floral morphology and native habitat, and therefore described the Guangxi specimens as a new variety, *C. hancei* var. *tsoi* H. S. Kiu. This illustrates that the re-discovery is of scientific interest and value.

Right: Natural habitat (circled) of *C. hancei* on Tsing Yi Island, HKSAR (Photo: AFCD)

The natural population and its habitat

Currently, the only known site of *C hancei* is a native woodland of approximately 0.4 ha on a steep slope facing northeast in the southern part of Tsing Yi. This woodland is isolated from the surrounding grassland by an array of giant rocks and the ridge of the slope. Field observations and analyses of the floristic composition of the existing woodland indicate that it might be the remnant of a primary forest which may have been preserved from the damage of occasional hill fires and other human activities in the past centuries by the shelter of the giant rocks and the steep and rugged topography.

In order to estimate the population size of *C. hancei* at the site, a field survey of the species was carried out in December 2005. As no *C. hancei* had been recorded outside the woodland at

Left: Juvenile plants of *C. hancei* conserved in the greenhouse of AFCD (Photo: AFCD)

the site, the woodland on the slope was considered the typical habitat of the species. Three permanent quadrats of 5m by 5m were randomly selected within the woodland to define the sampling area for the estimation. The population was estimated to be approximately 1700 individuals. Among the individuals surveyed, 53% and 14% of them were flowering and fruiting respectively and young seedlings were also observed *in situ* which demonstrated that the population is in a healthy condition.

Conservation measures

In situ conservation

In view of the special botanical interest, the site has been listed as a Site of Special Scientific Interest (SSSI). The SSSI is about 1.1 ha, covering the woodland which contains the *C. hancei* population, the surrounding grassland and an array of giant rocks as a protection buffer to the population. By listing the site as a SSSI, relevant government departments responsible for planning and development of the HKSAR are made aware of the special scientific value of the site and due consideration of its conservation should be given. When developments in or near the site are proposed, an environmental impact assessment would be required and the Agriculture, Fisheries and Conservation Department (AFCD) would be consulted about the potential impacts on the SSSI.

Ex situ conservation and reintroduction

The AFCD has attempted to propagate *C. hancei* since its rediscovery in 1997. Because the site is difficult to access and the population is small, only limited material has been collected. Some juvenile plants were collected and raised under nursery conditions. They have been kept in AFCD's greenhouse and raised in Shing Mun Arboretum for *ex situ* conservation. Cuttings were also taken from the natural population which resulted in an 80% survival rate. More encouragingly, the individuals kept in the greenhouse produce flowers and fruits with viable seeds. The seeds were subsequently sown with a 65% germination rate. Trial plots were also set up for reintroducing the species to suitable natural habitats and it is hoped that more populations of the species will become established in the wild.

Left: Croton hancei in its native habitat. Insert: Fruits (Photo: AFCD)

Conclusion

Because of its conservation importance and botanical interest, *C. hancei* is recorded in *Rare and Precious Plants of Hong Kong* (Hu, 2003). Using the 2001 IUCN Red List Categories and Criteria, the status of *C. hancei* in China is "Critically Endangered (CR)". It is hoped that the above measures will guarantee its continued existence in nature.

Left: *C. hancei* in its native habitat. Insert: Fruits (Photo: AFCD)

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The botanic gardens of Macau

Macau is located on the southwest bank of the Pearl River estuary, Guangdong province, China. It is composed of the Macau Peninsula, Taipa Island and Coloane Island. Although its total area is only 27 km^2, Macau has a population of almost half a million. Given this population density, with less than desirable urban greening and natural resources, the role of the Botanical Garden of Macau is important.

The history of botanic gardens in Macau starts with the "Flower Nurseries" during the Ming (AD 1368-1644) and Qing dynasties (AD 1644-1911) when westerners introduced many exotic plants. During the 18th and 19th centuries, a wealthy Portuguese merchant rented his palace (now renamed the Camoes Garden) to the British East India Company. The garden of the palace was used to grow exotic plants before sending them to the Royal Botanic Gardens in Kew, UK. The Camoes Garden is still running a tree nursery with an area of 4,500 m^2 and has a large number of old trees such as *Mimusops elengi, Artocarpus nitidus* subsp. *lingnanensis, Erythrina variegata* and *Syzygium cuminii*. Another site called a botanic garden is the Flora Garden, which was used as a tree nursery by the Macau Governor Tomas de Sousa e Rosa in the 19th century. The Flora Garden is home to many unique and rare plants, such as *Crescentia alata*, whose leaf resembles the shape of a cross.

Currently the only sizeable botanical garden in Macau is the Seac Pai Van Natural Park on Coloane Island. The park covers a total area of 8,450 m2, and can be divided into six zones:

1. Medicinal Plant Garden
Developed in 1994 with an area of 550 m^2, the Medicinal Plant Garden mainly holds traditional Chinese medicines collected from the wild and grown in trial grounds. The Garden has 137 species, which are divided into 17 categories based on the medicinal function of the plant. As the concept of "tonic tea" in the Guangdong region has a long history, many famous herbs are grown in the Garden. For example, the Garden has *Dendranthema indicum, Plumeria rubra* var. *acutifolia, Lonicera macrantha* and *Bombax ceiba*, which are the ingredients for the "Five Floral Tea"; as well as *Schefflera heptaphylla, Ilex asprella* and *Eriobotrya japonica* that are essential to make the "Twenty-Four Herbal Tonic Tea". The Garden also has rare plants like *Entada phaseoloides*.

2. Garden of Exotic Plants
Covering an area of about 550 m^2, the Garden of Exotic Plants, built in 1994, has 53 interesting plants, such as the "child-bearing" *Kandelia obovata*, the insect-eating *Nepenthes mirabilis* and *Drosera spathulata*, the energetic

Right: Arboretum of Seac Pai Van Natural Park, Coloane Island (Photo: Serviços de Zonas Verdes e Jardins)

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Left: A Corner of the Medicinal Plant Garden in the Seac Pai Van Natural Park , Coloane Island (Photo: Serviços de Zonas Verdes e Jardins)

Mimosa pudica, Solanum mammosum with beautiful fruits, and *Euphorbia tirucalli* that can generate energy.

3. Garden of Fragrant Flowers
Built in 1985, this Garden, also covers about 550 m^2, is full of fragrant flowers with 32 species including *Rosa multiflora, Jasminum sambac, Michelia figo*, and *Osmanthus fragrans*. This collection of flowers gives the Garden both a pastel colour and a constant fragrance throughout the year. Visitors are welcome to experience the marvel of fragrance therapy in this peaceful environment.

4. Arboretum
In the 1980s, the extensive single-species plantation of *Pinus massoniana* on the outlying islands was devastated by the pest *Hemiberlesia pitysophila* which launched a large-scale reforestation project involving 421 ha. The Arboretum, covering an area of 6,500 m^2, was set up in 1986 and opened to the public in 1997. With over 100 tree species belonging to 40 families, this Arboretum is a gene bank for tree species in Macau. It supplies a wide range of species for reforestation and some exotic species. Outside the Arboretum is a pond for people to enjoy fishing. Although the Arboretum's major objectives are scientific research and environmental education, it also provides nice scenery and recreation.

5. Pteridophyte Walk
The Pteridophyte Walk was built in 2001. Its aim is to conserve wild ferns in Macau by *ex situ* conservation and to cultivate ferns commonly used in Macau. There are 72 wild fern species in Macau, representing 3% of total fern species in China. The Pteridophyte Walk has 50 fern species.

6. Imported Plant Trial Zone
Also built in 2001, the Imported Plant Trial Zone has an area of about 300 m^2. The Trial Zone has contacts with 176 scientific research organizations in 55 countries. So far over 100 plant species have been successfully introduced into cultivation. Most of the introduced plants are trees for pedestrian sidewalks or urban greening and medicinal and succulent plants.

Due to the limited land in the territory, it is important to make good use of the parks and gardens of Macau, while organizing complementary activities such as visits, study trips, seminars, ecotours and exhibitions on plants and horticulture. These scattered parks and gardens can form a powerful network for urban greening and the conservation of biodiversity in the city.

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Restructuring Japan's botanic gardens through a contract system

Right: Display of medicinal plants at Higashiyama Botanical Garden, a local government garden in Nagoya (Photo: BGCI)

The botanic gardens of Japan are currently undergoing a large wave of restructuring.

In Japan there are over 200 botanic gardens of various types and sizes as well as facilities with some botanic garden attributes. Among these, approximately 130 relatively large gardens are members of the Japan Association of Botanical Gardens (JABG). About half of these gardens were established by local government at a prefecture, city or town level and are either managed directly, or by a group set up by the local government. Now, the management system of these botanic gardens is about to change in a significant way.

There has been an extensive review of local government administration systems in Japan due to a cut back in budget and government staff. Linked to this is a contract system that began in 2003 to reduce costs and improve services to residents. The system also aims to increase the contribution of the private sector. In the past, facilities such as museums and sports centres have been directly or indirectly managed by local government; now the management is contracted out to suitable companies or organizations. Botanic gardens have also been made a target of this system.

Formerly, botanic gardens were managed by government employees. Furthermore, the staff were employed by local government and each year the required budget was officially approved. Garden entrance fees and any other income was a form of local government revenue and if there was any shortage in operating expenses, a supplementary budget was prepared to deal with the situation. In cases where gardens are managed by an organization set up by a local public body, this basically remains the same.

The difference is that a local government employee (public official) deals with the management of the botanic garden and most of the work is carried out by staff hired separately by the organization.

However, under the newly created contract system, local government submits the annual budget required to manage the botanic garden and then recruits a company or organization to manage the garden with the budgeted funds. With regard to management policy and procedures, the plans provided are evaluated and the management is entrusted to an organization deemed to be appropriate. The selection of organization is made every 2-5 years. Any increase in profits achieved through cost reduction or increased entrance fees are kept by the organization. Application of this

Right: View of greenhouses at the Botanic Gardens of Toyama. This garden belongs to the Toyama prefecture and is an active botanic garden in Japan for research, conservation and education. (Photo: BGCI)

system to botanic gardens began in 2004 and is already in place in three gardens, with a further 29 gardens scheduled to be managed in this way in 2006. As of February 2006, each local government is in the process of selecting the organization to be entrusted with the management of the botanic gardens with a decision having been made in 18 of these gardens. A number of gardens will continue to be managed by the same organizations but there are also instances where different companies or organizations have been appointed.

As this system is applied, there are many problems and issues of uncertainty. The greatest uncertainty is ultimately whether contract organizations really possess the vision and staff with the necessary knowledge and skills to properly operate and manage a botanic garden.

Each botanic garden maintains collections of plants from all over the world that have been introduced and cultivated during the garden's history. Many gardens possess and display rare and endangered plants. Ultimately, there is a risk that these collections will suffer and disappear and their value for scientific research, conservation, display and education will be irredeemably reduced. As already mentioned, the main point of this system is cost reduction. Accordingly, because management is undertaken with a limited cost outlay, in cases where revenue from entry fees is insufficient it is easy to anticipate reductions in management costs and staff. Furthermore, it is also possible that highly skilled workers will be replaced with low cost staff in order to control labour costs. A high level of skill and deep understanding of plants is necessary to cultivate, manage and conserve the plants of botanic gardens. In order to achieve this, time needs to be spent on the education and training of staff. To be able to effectively display plants, it is necessary to spend long years and

months observing designs, tending landscape projects and cultivating plants. However, the process of appointing a garden management organization will occur every 2-5 years so it is to be expected that taking a long-term perspective will be difficult.

The objective of the JABG is to facilitate communication between botanic gardens in Japan; to increase understanding and address issues by sharing relevant information from inside and outside the country and; undertake development of botanic garden activities. Given that the tax system in Japan offers no benefit to providers of private contributions, the Association's operating expenses are largely covered by membership fees. There have already been withdrawals from the Association by the new contract organizations which have stopped membership payments as a means of cost reduction. As more new organizations are selected, it is likely that this precedent will be increased.

Botanic gardens not only maintain plant collections but are facilities that cultivate and conserve plants for the long term. The Association and each garden attribute the difficulty of maintaining the activities to the contract system whose main aim is cost reduction. It is unfortunate that botanic gardens have fallen into this state due to the sweeping trend of administrative reform aimed at local government since Japan's economic crash in the 1990's.

At the moment, it is necessary to raise awareness and understanding about the role of botanic gardens and ensure that local governments appoint organizations that will adequately manage botanic garden activities. Also there is a need to highlight the problem in the community to mobilize public opinion for good management of the gardens. Further, it is important to check that each garden under contract is operated well and to understand the situation clearly.

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Above: View of Higashiyama Botanical Gardens, a local government garden in Nagoya (Photo: BGCI)

Left: Annual presentation of research projects undertaken by the staff at the Botanic Gardens of Toyama (2006). Under a contract system research in botanic gardens might be reduced. (Photo: BGCI)

Sign of *Malus micromalus* at the Kochi Prefectural Makino Botanical Garden. Dr. Tomitaro Makino was a famous Japanese botanists and named this plant. (Photo: BGCI)

Author: Tomohisa Yukawa

Status of *ex situ* conservation of threatened Japanese plant species in Japanese botanic gardens

Right: *Polemonium kiushianum* at Shinjuku Gyoen National Garden in June 2005. The plant was displayed as part of the *Investing in Nature* travelling exhibition, "Plants for Life - Conserving Threatened Plants Species". This species is endemic to the Bonin Islands and critically endangered with only one specimen in the wild. It is a target species for restoration by Tokyo University Botanic Garden (Photo: BGCI)

Introduction

In the last six years, the Conservation of Endangered Plants Committee of the Japan Association of Botanical Gardens (JABG) and the Tsukuba Botanical Garden of the National Science Museum have undertaken two surveys on the *Status of* ex situ *conservation of threatened plant species* in Japan. The first survey ascertained the work on threatened plant species by association members and was published by the Conservation of Endangered Plants Committee (2001). In the second survey, detailed data concerning the threatened Japanese plant species held by each garden was collected and analyzed (Yukawa, 2004). Some of the results, apart from sensitive information such as the habitat has been posted on the JABG website (2004). This paper summarises the results of the second survey to illustrate the status of biodiversity conservation in Japanese botanic gardens.

Survey Procedure

A copy of Red List Plant Edition (Environmental Agency, 1997) was sent to the JABG members for them to indicate if they held any of the 1536 taxa listed as extinct, threatened or semi–threatened. The data for each taxon was entered on an MS Excel spreadsheet (Table 1). The fields are similar to BG Plants, the database of cultivated plants for research purposes which has been developed by university botanic gardens. Since the start of the survey, the Environmental Agency published a revised Red List (2000). This Red List with 1835 threatened taxa was used in the analysis of the data. However, it is to be expected that due to the timing of the survey some target species might not be listed.

Response

A response was received from 87 of the 137 member gardens (approximately 64%). Of these, 30 gardens (approximately 22%) responded "no relevant plant species". There was a swift response from gardens that have developed their own databases which indicates that a database is thought to be an important facility for managing living collections. As this was a complicated survey the response rate is considered fairly good. However, as there was no response from 50 gardens and 30 gardens had no relevant species indicates that there are many gardens that grappling with the problem of conserving biodiversity.

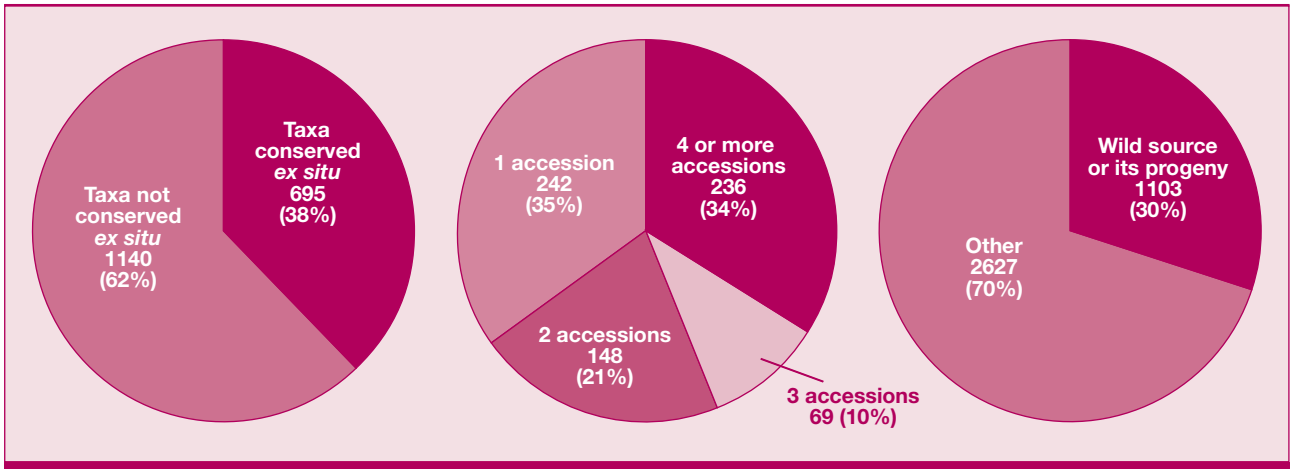
Results

The results are shown in Figure 1. The total number of threatened plants in ex situ conservation was 3730. This comprised 695 taxa (approximately 38% of the 1835 target taxa from the *Red Data Book Vascular Plant Edition*) (Figure 1a). 459 taxa (66%) had three accessions or less (Figure 1b) and 30% (1103) accessions were of wild origin (Figure 1c).

It is likely that the total of 695 threatened plant taxa held in association gardens is lower than the true figure as this was a complicated survey and the earlier Red List was used. However, it is clear that the conservation status of threatened plant species in Japanese botanic gardens is grave. Further the diversity within species is low and there is only original habitat date for 30% of the accessions.

Conclusion

It is proposed that all Japanese botanic gardens should aim to conserve all Japanese plant species as either living plants, seeds or spores, however, the first priority is the conservation of threatened taxa. The list of those taxa which are in *ex situ* conservation in members gardens is posted on the JABG website and will provide the



a) Number of threatened taxa in ex situ *collections (total number of threatened taxa 1835 Environmental Agency, 2000)*

b) Number of accessions of each taxon (total number of taxa 695)

c) Origin of accessions (total number of accessions 3730)

Figure 1 Summary of the results of the survey on the status of ex situ *conservation of threatened Japanese plant species in botanic gardens*

1. Holding institution number
2. Accession registration number
3. Family name
4. Japanese family name
5. Generic name
6. Specific epithet
7. Infra-specific name
8. Classification – 1: seed plant, 2: gymnosperm, 3: pteridophyte, 4: moss
9. Japanese name
10. English name
11. Local name (dialect name)
12. Holding institution
13. Type of material in conservation – 1: living plant 2: cutting 3: seed 4: spore 5: pollen 6: tissue culture 7: other 8: unclear
14. Conservation status – 1: not threatened 2: threatened 3: extinct 4: unclear
15. Section within garden
16. Herbarium specimen (number and herbarium code)
17. Date of acquisition
18. Source of acquisition
19. Acquisition institution number
20. Material received – 1: living plant 2: cutting 3: seed 4: spore 5: pollen 6: tissue culture 7: other 8: unknown
21. Origin – 1: accession collected from the wild 2: accessions obtained from propagation of wild material 3: accessions other than 1 or 2 4: unknown
22. Place of origin
23. Offer conditions – 1: provide on request 2: consider providing on request 3: provide on payment 4: will not provide 5: offer conditions undecided
24. Detailed information
    (1) Flowering, fruit bearing, etc.
    (2) Classification
    (3) Flora
    (4) Morphological characters
    (5) Physiological attributes
    (6) Ecological attributes
    (7) Propagation method
    (8) Other
25. Reference

Format for database of Japanese threatened plant species maintained in botanic gardens

baseline for Japanese botanic gardens as they make progress towards the *ex situ* conservation of threatened Japanese taxa. The Association members can obtain more detailed information through the executive office of the JABG. The results of this survey will be used for the development of activities of the JABG and every garden.

Acknowledgements

I wish to express my deep gratitude to the members of the JABG who cooperated with this survey especially the Conservation of Endangered Plants Committee. Part of the expenses for this research were covered by a scientific research grant (subject 15201050) from the Ministry of Education, Culture, Sports, Science and Technology and the National Science Museum.

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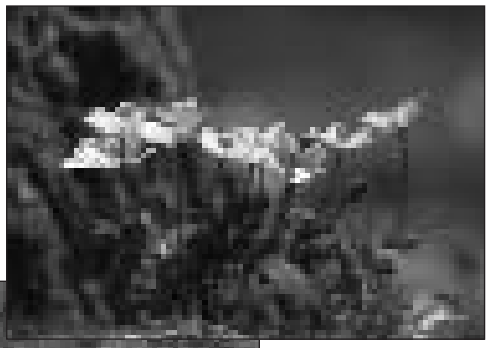
Below: *Rhododendron boninense* at Shinjuku Gyoen National Garden in June 2005. The plant was displayed as part of the *Investing in Nature* travelling exhibition, "Plants for Life - Conserving Threatened Plants Species". This species is endemic to the Bonin Islands and critically endangered with only one specimen in the wild. It is a target species for restoration by Tokyo University Botanic Garden (Photo: BGCI)

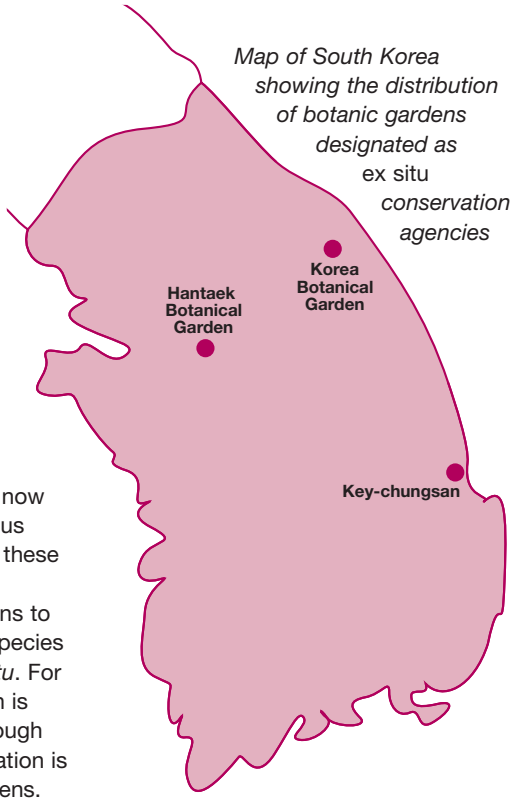
Author: Song Ki-Hun

Plant conservation in South Korean botanic gardens



Right: *Jeffersonia dubia* at Hantaek Botanical Garden (Photo: Song Ki-Hun)

Below: Restoration of *Hylotelephium ussuriense* into the wild by staff of Hantaek Botanical Garden (Photo: Song Ki-Hun)



Map of South Korea showing the distribution of botanic gardens designated as ex situ *conservation agencies*

Korea has successfully built a strong foundation for economic development starting in the 1970s. However, it neglected to include the protection of the environment and South Korea is now faced with the extinction of various animal and plant species. Under these circumstances, the Ministry of Environment has put forward plans to conserve rare and endangered species by conservation *in situ* and *ex situ*. For this purpose, *in situ* conservation is currently being implemented through legislation, while *ex situ* conservation is largely entrusted to botanic gardens.

Thus far, five botanic gardens have been designated ex situ conservation agencies for plants: Halla Arboretum, Jeju Province; Hantaek Botanical Garden, Gyeonggi Province; Yeomiji Botanical Garden, Jeju Province; Key-chungsan Botanical Garden, Gyeongsangbuk Province and Korea Botanical Garden, Gangwon Province.

Hantaek Botanical Garden, Key-chungsan Botanical Garden, and Korea Botanical Garden are privately owned. Hantaek Botanical Garden grows 12 species for conservation and restoration: *Rodgersia tabularis, Crypsinus hastatus, Eutrema wasabi, Jeffersonia dubia, Iris odaesanensis, Iris dichotoma, Hylotelephium ussuriense, Abeliophyllum distichum, Brasenia purpurea, Paeonia obovata, Thalictrum coreanum*, and *Corylopsis coreana*. Key-chungsan Botanical Garden

Left: Wildflower meadow at Korea Botanic Garden, Gangwon Province (Photo: Song Ki-Hun)

steadily propagates and restores 10 local plants from Ulleungdo Island and the east coast of the Gyeongsangbuk Province: *Cotoneaster wilsonii, Trillium tschonoskii, Iris odaesanensis, Jeffersonia dubia, Hylotelephium ussuriense, Berchemia berchemiaefolia, Bupleurum latissimum, Scrophularia takesimensis, Lilium cernuum*, and *Thalictrum coreanum*. Lastly, Korea Botanical Garden has 10 species identified for *ex situ* conservation: *Jeffersonia dubia, Rhododendron aureum, Paeonia obovata, Iris odaesanensis, Echinosophora koreensis, Arctous ruber, Eleutherococcus senticosus, Brasenia purpurea, Thalictrum coreanum*, and *Leontice microrrhyncha*.

On the other hand, Halla Arboretum, which is managed by Jeju City, conserves 12 local species of Jeju Island: *Hibiscus hamabo, Aerides japonicum, Cymbidium kanran, Quercus gilva, Paliurus ramosissimus, Euchresta japonica Benth, Saururus chinensis, Brasenia purpurea, Sarcanthus scolopendrifolius, Chloranthus glaber, Neofinetia falcata, Cymbidium lancifolium*, and *Asplenium antiquum*. Yeomiji Botanical Garden managed by Buguk Development Co., Ltd. plans to develop artificial propagation techniques for 12 species of plants in danger of extinction and protected wild plants, and restore them to their habitats in Jeju island (*Aerides japonicum, Diapensia lapponica, Psilotum nudum, Quercus gilva, Isoetes japonica, Cymbidium nipponicum, Chloranthus glaber, Euchresta japonica Benth, Cymbidium kanran, Paliurus ramosissimus, Saururus chinensis* and *Hibiscus hamabo)*.

The designation of *ex situ* conservation agencies is essential to establish a preventive system to minimize the extinction of Korean native plant species. There needs to be *ex situ* conservation measures for endangered species as well as strong measures for *in situ* conservation of wild species.

In this regard, Korean botanic gardens are recognized for their importance as *ex situ* conservation agencies. They will continue to promote in earnest various projects to conserve, propagate and restore endangered species. This will maintain the biodiversity of life in Korea through artificially propagating wild plants in danger of extinction, which are difficult to conserve outside their habitats and to restore them to their proper habitats.

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Above: *Iris odaesanensis*

Left: *Iris odaesanensis* bed at Key-chungsan Botanical Garden (Photo: Song Ki-Hun)

Author: Song Ki-Hun

The present status of South Korean botanic gardens

The history of Korean botanic gardens began in 1922 when the Hongneung Arboretum, Seoul was developed in the Forestry Experiment Station in Cheongnyangni. However, botanic gardens have declined through a period of colonization, war and subsequent poverty that took place afterwards. It was only in the 1960s when botanic gardens opened one after another, such as Kwanak Arboretum, Gyeonggi Province; Chollipo Arboretum and Gowun Botanic Garden, Chungchungnam Province and Keechungsan Botanic Garden, Gyeongsanbuk Province. As the culture of enjoying botanic gardens gradually spread among the public and the national economy improved, many new botanic gardens and arboreta were constructed during the last few years. There are now 38 botanic gardens established or under construction, and several dozen are planned.

Below: Gowun Botanic Garden, Chungchungnam Province (Photo: Song Ki-Hun)

On the other hand, some people were concerned that the numbers of botanic gardens were growing in quantity but without the support of a basic infrastructure. Recognizing this problem, the Korea Forest Service commissioned an expert group to make a survey of Korean botanic gardens, which is described below (Korea Forest Service, 2005).

The group surveyed eighteen gardens and looked at staff skills, the number of taxa, plant collections policies, collections management, the source of collections, research, visitor numbers and education.

First, it was discovered that the number of skilled botanic staff was very low compared to major botanic gardens in foreign countries. A shocking result was that ten public arboreta did not access to even one expert. Privately-owned arboreta had one to eight experts.

Second, a survey of the number of taxa for 18 botanic gardens revealed that three had less than 1,000 taxa, eleven had between 1,000 and 2,000, and four over 3,000. Chollipo Arboretum had the highest number with 10,318 taxa.

Third, a survey of collection policies for each botanic garden found that six public arboreta and two privately owned arboreta focus on local native species in line with the ecology of the area; one public and one private arboretum had collections of taxonomic groups such as the Magnoliaceae and Aquifoliaceae; one public and two private arboreta collected species for special purposes such as landscape trees and native plants; and six public and two private arboreta collected mainly for the purpose of the acquisition of genetic resources.

Fourth, a survey of the management of collections in the gardens found that 12 of the 18 arboreta surveyed managed them properly while six of them were unsatisfactory. Five of them maintained regular records, six of them inadequately, and seven of them did not keep any records. The management of plant records is in its early stages in Korea and the assignment of accession numbers and the labels that are required for the collection, display, and propagation was only well-managed in one institution, eleven are in the planning stage and six did not have any plans. Label management also requires expertise, expense and effort; seven of them produced and maintained their own labels, ten managed only partially with purchased labels and one did not use them at all.

Fifth, a survey of the source of plant material revealed that only five of them have registered for Index Seminum. For domestic exchange of plant species, eleven of them had exchanged with three or more Korean arboreta or botanic gardens while seven depended

on purchasing material. Three of them obtained exotic species through exchanges with five or more foreign arboreta or botanic gardens while three collected only limited species through a few foreign arboreta or botanic gardens. Twelve of them purchased exotic plants from other arboreta or seed merchants.

Sixth, research was found to be very poor except for some arboreta. Regardless of public or private arboreta, almost no research projects were carried out by the arboreta themselves or by others using the collections.

Seventh, a survey of visitor numbers to botanic gardens showed that one has less than 10,000 visitors per year on average, four between 10,000 and 100,000, nine between 100,000 and 500,000, and two over 500,000. This shows a great discrepancy with the number of visitors to botanic gardens in developed countries.

Eighth, education in arboreta was surveyed such as guidebooks, exhibitions and events. Eleven organizations provided guided tours but six did not and three of them trained guides and used them regularly, but thirteen did not. On the other hand, nine of them organized regular exhibitions and events each year while six did not. Only three of them had guidebooks, tours, guide training programmes, exhibitions. Three of them had no education activities.

To address these problems, the expert group presented various suggestions to the Korea Forest Service for the future development of Korean botanic gardens, which are summarized below.

First, arboreta and botanic gardens are required to clearly state their plan to acquire a minimum number of experts when registering their establishment with the government. There is a government Act that promotes the work of arboreta and there are grants available for arboreta (Republic of Korea, 2001).

Second, for the management and exchange of plant genetic resources, efforts must be made to acquire plant species through reliable tree nurseries or botanic gardens. Even after the establishment of botanic gardens, they should actively seek to exchange plant genetic resources through regular exchanges with domestic and international botanic gardens by registering for *Index Seminum*. Moreover, for systematic information management of the acquired species, the history and origin of the material, place of seed collection, display, propagation and propagation methods must be built into a database to enable continuous tracking.

Third, to stimulate research projects, the Korea Forest Research Institute and forest environmental research centres of each province must collaborate to promote joint research projects between the Korea National Arboretum and regional or privately owned arboreta.

Fourth, to improve the public's understanding of botanic gardens and promote the importance of plants, well-organized education programmes to train guides on botanic gardens are needed.

This report briefly commented on the present status of Korean botanic gardens and their future tasks. The most important thing to remember, however, is that the development of domestic and international botanic gardens through mutual cooperation is significant for all human beings on earth.

Above: Garden of Morning Calm, Gyeonggi Province (Photo: Song Ki-Hun)

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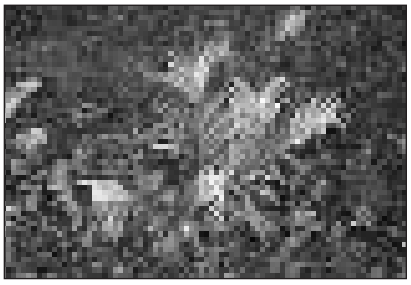
Right: Chollipo Arboretum (Photo: Song Ki-Hun)

Author: Wen-Liang Chiou

Developing an action plan for Fushan Botanic Garden: A dream for people who appreciate biodiversity



Right: *Amentotaxus formosana* Li propagated from a cutting. It is endangered (EN) and a priority candidate for *ex situ* conservation (Photo: Wen-Liang Chiou)

The Fushan Botanic Garden (FBG) belongs to the Taiwan Forestry Research Institute (TFRI) and occupies1097 ha in the mountains of north-east Taiwan. It was established in 1990 and opened to the public in 1992.

The garden has natural forest with 30 ha for exhibiting the plant collection. It is a site of long-term ecological research (LTER) in Taiwan with about 20 research projects each year undertaken by scientists of various institutes and includes the first large-scale subtropical forest plot in the world. FBG has a section to grow threatened or endangered species which is also used for education. The garden has an education centre and produces interpretation material.

The Mission of FBG is to:

- ensure the conservation and protection of biodiversity in FBG, both *in situ* and *ex situ* and to provide material for science, environmental monitoring and education and the maintenance of genetic resources.
- enhance the knowledge of useful plants, collect, grow and display these plants to conserve genetic resources and make people aware of the importance of biological diversity and the sustainable use of plants through education programmes.
- coordinate and integrate the above issues through research, education, and practical actions.

This article briefly describes the action plan for FBG which was developed using a SWOT analysis.

Objectives and actions

1. Conservation objectives

1.1 in situ

Conserve an ecosystem which provides an example of the natural ecosystem, flora and fauna of north-east Taiwan.

To achieve this objective, FBG should:

1.1.1 enhance communication between the local government and aboriginal people to raise their awareness of the importance of biodiversity. The aboriginal people could be involved in conservation e.g. patrolling, collecting and growing plants for FBG, which would improve their economic well-being and lessen the hunting pressure.

1.1.2 promote, invite, and collaborate with other institutes to undertake research into the distribution, reproductive biology and management of wildlife to provide feasible strategies to ensure the sustainable use of these natural resources.

1.1.3 monitor wild populations of threatened plants and integrate *ex situ* conservation to ensure the sustainable use of plants.

1.1.4 ensure staff understand the relevant legislation.

1.2 ex situ

Ensure the selected plants or seeds/spores are conserved *ex situ* and enable them to be sustainably used.

To achieve this objective, FBG should:

1.2.1 prioritize the target plants. This should include a National Plant Collection of Taiwan. FBG could collaborate with other institutions to grow economically important plants to take the pressure off wild plants.

1.2.2 identify plant collections for display and education. The present collections of trees and shrubs could be augmented with thematic collections such as epiphytes which are adapted in the humid habitat and herbs for education as well as commercial use.

1.2.3 implement ethnobotanical research and collections. This research will work closely with the aboriginal people.

1.2.4 maintain a seed bank at the headquarter of TFRI.

1.2.5 collect and identify seedlings. Develop a herbarium of seedlings at different developmental stages, grown at

FBG, to aid identification of materials collected in the field. The lack of knowledge of seedling morphology is one of the main problems of research into forest dynamics.

1.2.6 manage the living plant collection.

2. Education objectives:

2.1 To enhance visitors' awareness of the importance of biological diversity and the sustainable use of plant resources

To achieve this objective, FBG should:

2.1.1 enhance staff awareness of the spirit of the *Convention on Biological Diversity* and the *Global Strategy for Plant Conservation*.

2.1.2 increase the number of volunteers and organize them properly.

2.1.3 train travel agency guides. About half of FBG's visitors are organized by travel agencies. FBG should give training courses and issue badges for qualified guides.

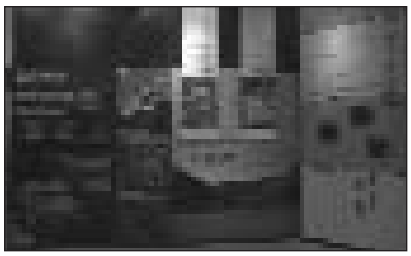
2.1.4 publish a local Flora as soon as possible.

2.1.5 display living plant collections which illustrate plant diversity.

2.1.6 use the natural ecosystem for interpretation. In particular, the function of the natural forest and water resources.

2.1.7 improve the education programmes of the education centre. For example, a programme on 'evening ecology' to help people understand the cycle of a day in nature and interpret research data for the public.

2.1.8 develop relevant interpretation systems for different groups of visitors.



2.2. Promote FBG as a resource for academic education and training

To achieve this objective, FBG should:

2.2.1 provide the garden's resources to universities. In particular materials for the taxonomy and ethnobotany, and facilities for horticultural teaching and research. FBG also has accommodation and a restaurant.

2.2.2 collaborate with universities and other research institutes and encourage university students to use the resources for research.

2.2.3 organize symposia, workshops and/or training courses on relevant topics.

2.2.4 offer the facilities to government institutes and NGOs for meetings on related subjects. This will favour good policies for environmental development.

2.3 Develop FBG as a centre for environmental education for elementary schools

To achieve this objective, FBG should:

2.3.1 train FBG's staff to understand a child-friendly programme.

2.3.2 invite school teachers or experts to participate in the programme development.

2.3.3 encourage volunteers to be involved in this programme. Most of the volunteers of FBG are teachers of elementary schools and could assist in the programme design.

2.3.4 enhance teachers' awareness and skill in environmental education through courses at FBG.

Further recommendations

Other recommendations which will support the action plan and thus help implement the objectives on conservation and education are to:

- modify the access facilities for visitors such as the young and old and those with special needs.
- implement more and wider research to provide theoretical, empirical, and practical actions.

Above: View of garden (Photo: BGCI)

- establish a network of all botanic gardens in. Although the gardens are located in different regions, all are easy to reach. A network will avoid overlap in effort and maximize the use of resources; every botanic garden should develop their unique programmes and share the experience and common tools used such as the record system. The network can extend to other organizations, such as museums, national parks, tourist authorities, the media, and so on, to use the limited resources to the maximum.
- integrate management of different objectives to ensure that work is undertaken in a way which meets the objectives in the defined time and within the budget.
- circulate the draft plan to all staff and outside FBG in order to get feedback and comment.
- evaluate the plan periodically to ensure its feasibility and achievability.

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Left: Interpretation at the Nature Centre (Photo: Min-Hsiung Chou)

Author: S. Chiu and T. Yang

The history, conservation challenges and future tasks of the Botanical Garden at the National Museum of Natural Science, Taichung

Right: The conservatory at the Botanical Garden (Photo: BGCI)

The Botanical Garden associated with the National Museum of Natural Science was planned and designed in March, 1994, established by January and opened to public in July, 1999. The main objective of the museum's garden is to provide a 4.5-ha "green space" for city dwellers to experience Taiwan's native plants at close quarters. It also provides a landmark, a towering greenhouse with a diverse collection of rain forest species from all over the world.

The themes of the exhibits in the Garden reflect the museum's scientific collections and research, in particular Taiwan's lowland ecology.

- Northern Lowlands: this vegetation is influenced by the northeastern monsoon and these exhibits represent a humid environment with tree ferns and *Machilus-Quercus* broad-leaved forest species.
- Central Lowland: this vegetation has the mildest and most favourable climate for plants and represents a deciduous as well as a broad-leaved mixed forest.
- Southern Lowlands: this is one of the most important agricultural regions and the destruction of native vegetation has resulted in the emergence of wasteland and areas of secondary growth.
- Monsoon Rain Forest: this is an environment in which the northeastern monsoons alternate with southwestern monsoons and the vegetation is characterized by dense thickets and highly branching trees with coarse and dry leaves.
- Littoral Forest: this forest include species possessing buoyant fruits for sea dispersal.
- Coral Atoll: trees grow in the cracks in the porous coral and are characterized by thorny forests along the ridges, aerial roots in the valleys (*Ficus* sp.) and buttresses on mountain slopes.
- Eastern Lowlands: this area is confined to alluvial cliffs and steep terraces. This area has a collection of 50 species including the relic and endangered Taitung Cycad (*Cycas taitungensis*).
- Orchid Island: a tropical volcanic island off the southeastern coast of Taiwan which possesses a vegetation with a closer phytogeographical affinity with the Philippines than Taiwan.

The giant glass conservatory simulates the complex rain forest with towering trees, epiphytic bromeliads, orchids and wetland as well as fish from the Amazon River.

The collection of living plants is currently about 200 families with 2000 species and varieties. It includes an orchid collection (over 200 taxa), a palm collection (over 157 taxa) and *Begonia* collection (nearly 100 taxa).

Left: Visitors to the Botanical Garden (Photo: BGCI)

Left: Map of the Botanical Garden (Photo: BGCI)

The Botanical Garden also holds a series of special exhibitions and events such as a 'feast of mushrooms', invasive plants which was associated with a symposium and work shops, events such as Daylilies and Carnations for Mother's day, Water Lilies and Lotus for summer festivals, *Chryanthmum*/*Helianthus* for autumn festivals, and *Poinsettia* for winter holidays. These exhibitions increased the collections of living plants and informed people about plants in relation to their lives. Further, all the related educational activities and demonstrations for the exhibitions were fully-booked shortly after the announcement. During the museum's 20th anniversary, on a very cold new year's day, the garden visitors even exceed two thousand. The Orchid Association in Taiwan also holds its exhibitions in the Garden which encourages interest and research.

The Garden is supported by the Naturalist Center which was opened in 1995. Visitors can bring their own herbarium specimens for identification and use the microscopes and reference guides or seek assistance. There is also another prominent plant-based display at the museum called the 'Made in Taiwan Project'. This exhibition uses over 130 different plants of Taiwan collected from the 13 different areas to make hand-made paper to create artworks reflecting the different areas.

The second stage of development is to increase and strengthen the living collections and expand the attractions. This will include the introduction of more seasonal attractions such as blossom announcements, special exhibitions on conservation research and the development of souvenirs.

Currently, there are plans to design a palm garden and Australia garden. The Australian government presented two Wollemi Pines (*Wollemia nobilis*) to commemorate the Museum's anniversary in 2005. A press conference and special exhibition was held which introduced the concept of conservation to the public.

Cooperative projects are already in place with the National Taiwan University Experimental Forest in Sitou for the cultivation of bamboo, fern medicinal plant species as well as National Taiwan University Highland Experimental Farm in Meifong to cultivate ferns. The Garden is also working with the Seed Improvement and Propagation Station in Sinshe on *Arisaema* species, ferns and medicinal plants. It also plans to collaborate with the National Taichung Agricultural Senior High School to expand the nursery station. In the next ten years, it is expected that the Garden will achieve a collection of 10,000 species, become a major tourist destination at Taichung, an important venue for scientific research a large outdoor classroom for school groups and an internationally recognized botanic garden.

In the future, the role of botanic gardens in education and conservation, particularly relating to the sustainable use of plant resources and achievement of local and global sustainability will increase in importance, and gardens should work collectively to focus the message and thus increase the efficiency of such a programme.

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Below: Visitors to the Botanical Garden (Photo: BGCI)

Author: Gunjilmaa Byambaa

Conservation and the development of plant resources at the Botanic Garden of Mongolia and the Institute of Botany

The Botanic Garden of Mongolia was established in eastern Ulaanbaatar in the 1970's in order to conserve the native and rare flora of Mongolia and provide economically useful plant species for agriculture, forestry and horticulture. It is part of the Institute of Botany of the Mongolian Academy of Sciences which consists of five departments: Plant Systematics, Plant Anatomy and Physiology, Forest Phytosociology, Vegetation Ecology, and the Botanic Garden and plant resources.

The garden occupies 32 ha with ornamental trees, shrubs, herbs and bulbs (with special collections such as *Paeonia* and *Iris*), trial grounds and greenhouses. It has 19 staff which consists of 13 scientists (five with higher degrees - D.Sc. and 4 Ph.D.) and 6 technical specialists. There are 56 native taxa in cultivation (see Figure 1). Since its foundation, the garden has undertaken research on the breeding of ornamental trees and shrubs, landscape design and construction, greening the capital and published city garden manuals and adopted 20 standards, certified by the State Centre for Standardization.

Present work focuses on

- Research into the ecology and infraspecific variation, cultivation, threats, conservation and breeding of native ornamental and useful shrubs for greenhouse and outside cultivation
- Maintenance of living collections, ex situ and in situ conservation, propagation of rare and endangered native taxa to provide a living plant and in vitro gene bank
- Research into the biological activity of the forms selected for cultivation (e.g. Mongolian medicinal plants) in relation to the environment and local use.
- Cultivation and selection of exotic plants
- Development of protocols for the cultivation of plants for each genus

Wild collection of 133 species of plants is prohibited by law and 128 higher and lower species are registered in the Red Book of Mongolia (Shiirevdamba, 1997), which supports their conservation. Over 20 endangered plants are now in cultivation

Study of economic plants
The aim of this work is to study: the distribution of rare, endangered and economic plants, the economic evaluation of plants (such as medicine, painting materials and fruits) and protocols for their use.

For example, the department has worked on the development of rare and native economic plants such as *Thermopsis, Glycyrrhiza uralensis, Adonis mongolica* and *Cistanche deserticola* and *Hippophae rhamnoides* (Ochirbat, 2005). The research includes the distribution, biological and industrial use, restoration, ecological and economic aspects, assessment scheme and production of an information file on its cultivation. The department has produced dissertations (10), internal reports and bulletins, books and news items for the public, monographs (320), standard and technical manuals, proposals, strategies and illustrations.

Detailed morphological and chemical research has been undertaken on over 100 Mongolian species for vegetable dyes (60 genera of 40 families) such as *Rheum* (10 sp.), *Galium* and *Urtica*. Technological protocols have been defined to make colours such as yellow, green, brown, and pink, black and blue for wool and cashmere under varying conditions. The department has also undertaken a project on bee breeding which has led to an increase in income for the production of honey and related.

Institute of Botany

The Institute of Botany employs 54 scientists (most with higher degrees including 9 D.Sc., 19 Ph.D, 21 M.Sc.).

Current research topics are:

- Plant systematic and taxonomy
- The bio-resource, bio-ecological, cytological and physiological researches of useful, rare and endangered plants
- The long-term monitoring research of growth, development and dynamics of forest
- Vegetation dynamics in different zones

- The biology of introducing plants into cultivation in the botanical garden
- The technology of increasing fertility, regeneration and cultivation of stored germplasm
- Climax vegetation, succession and changes of Orkhon-Selenge valley meadow and steppe ecosystem

The Institute collaborates with research institutes and universities in over 15 countries such as Russia, USA, Japan, Germany, China and Israel. These include: the A.N.Severtsov Institute of Ecology and Evolution Russian Academy of Sciences (RAS); the Komarov Botanical Institute RAS; the Baikal Institute for Natural Resources, RAS; the Institute of Botany, Chinese Academy of Sciences (CAS); the Institute of Ecology and Geography CAS; Department of Botany, University Museum, University of Tokyo, Japan; Okayama University of Science, Japan; Graduate School of Natural Science and Technology, Kanazawa University, Japan; Institute of Geobotany and Botanical Garden, Martin Luther University, Halle, Germany; Institute for Desert Research, Israel; Krasnoyarsk Forest Institute, Russia.

Since 1970, the Joint Russian-Mongolian Complex Biological Expedition (JRMBE) has undertaken large-scale integrated research in Mongolia. The main aim of this expedition research work is bio-resource studies, eco-biological assessment and developing procedures for its proper use, restoration and conservation. The work plan of this cooperation covers a wide range of topics: vegetation and flora, plant cover, botanical and geographical studies, agricultural and pastureland, forest and animals.

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Left: Greenhouse for introducing plants into the garden (Photo: Institute of Botany)

Below: *Hippophae rhamnoides* berries (Photo: www.floralimages.co.uk)

Native taxa in cultivation at the Botanic Garden of Mongolia

Alliaceae
Allium altaicum
A. condensatum
A. macrostemon
A. obliquum
Asteraceae
Aster altaicus
A. alpinus
A. mongolicus
A. sp
Echinops latifolius
Brachanthemum mongolicum
Chrysanthemum zawadskii
Olgaea leucophylla
O. lomonossowii

Caryophyllaceae
Dianthus versicolor
D. sp

Liliaceae
Lilium pumilum
L. martagon
L. dahuricum
L. buschianum
Hemerocallis lilio-asphodelus
H. minor
Tulipa uniflora
Polygonatum odoratum
Asparagus sp

Paeoniaceae
Paeonia anomala
P. lactiflora

Polygonaceae
Rheum undulatum
Campanulaceae
Campanula glomerata

Crassulaceae
Rhodiola rosea
Sedum aizoon
S. purpureum

Leguminosae
Sophora flavescens

Geraniaceae
Geranium pratense

Plumbaginaceae
Goniolimon speciosum

Labiatae
Lamium album
Phlomis tuberosa

Hypericaceae
Hypericum ascyron

Ranunculaceae
Anemone crinita
Trollius asiaticus
T. hybridus
Adonis mongolica
Clematis tangutica
Delphinium elatum
Ranunculus japonicus

Scrophulariaceae
Lancea tibetica

Iridaceae
Iris bungei
I. dichotoma
I. flavissima
I. halophila
I. lactea
I. potaninii
I. sibirica
I. tenuifolia
I. tigridia
I. ventricosa
I. sanguinea

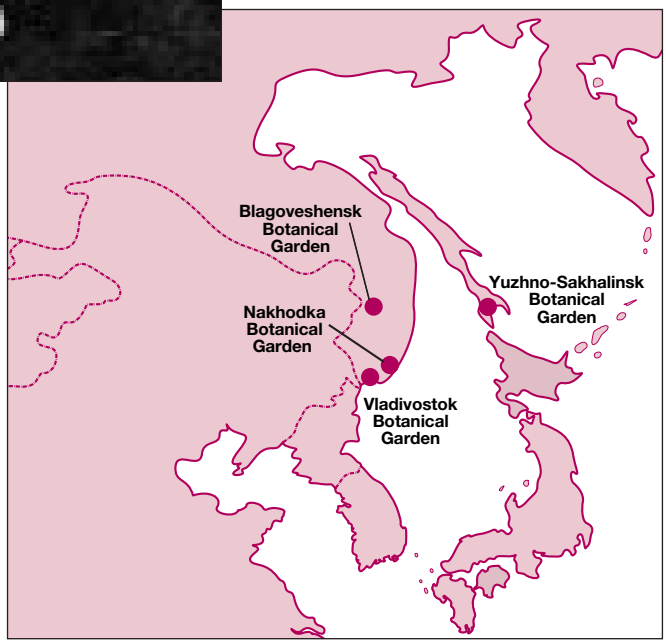
Author: Alexander V. Galanin

The Botanic Garden Institute of the Far Eastern Branch of the Russian Academy of Sciences: securing protection of rare and endangered plants in the Russian far east

Above: Endangered plant *Hepatica asiatica* in the park area of Botanic Garden FEB RAS (Photo: Marina Koldaeva)

Apart from the North Caucasus, the South Russian far east has the richest plant diversity in Russia. The region, including the Amur River Basin, Khabarovsk region, mountainous region of Sikhote-Alin Range, Khasan District and southern portion of Primorskii Krai has over 4,000 vascular plants.

The reason for such high floristic diversity is due to a complex geological history, weather extremes and a centennial cyclic climate change between the arid and humid epochs.



Map to show the distribution of botanic gardens in the Russia far east

The area was not glaciated in the Pleistocene as in northern Europe and during the humid epochs, forest species were dispersed westward to the Khentei Mountains and during arid epochs, steppe species spread eastward reaching the Sikhote-Alin Mountains. The fall of temperature in glacial times caused migrations of boreal and arctic-boreal species southward, so they reached the mountains of Korea. This explains the complex mixture of geographic and genetic elements in the local floras of the South far east. Typical examples include Ayan Spruce (*Picea ajanensis*) and Shrub Pine (*Pinus pumila*), in the Sikhote-Alin vegetation, which quite often grow with *Aralia manshurica* and *Rhododendron fauriei*. Another example is *Filifolium sibiricum*, a dominant species of the Dahurian steppes which inhabits meadows of the Khanka Lake area.

Almost half of the plant species included in the *Red Book of the Russian Federation. Plants* (1988) (83 species including 6 cryptogamic plants and 6 Gymnospermae) are found in the southern part of the far eastern region. This includes 24 woody plants such as *Microbiota decussata*. A significant number (22 of 83) endangered species grow on Sakhalin Island and/or Kuril Islands. Many species of the South Russian far east are at the northern or southern limits of their range and are

therefore rare, sensitive and vulnerable, particularly to global warming. However, anthropogenic factors such as logging, forest fires and industrial and urban development are more of a threat to rare species than climate change and the construction of dams and power stations threaten species of wetlands and marshes.

Nature reserves and national parks, in the South Russian far east (13), play an important role in the conservation of endangered species, but these species are vulnerable due to few and small populations and are easily disturbed. For this reason the priority of botanic gardens is to conserve rare and endangered species through living collections. The Botanic Garden of the Far Eastern Branch of the Russian Academy of Sciences (FEB RAS) has collections with many rare species of the Manchurian flora (e.g. Araliaceae, paeonies, irises, lilies, Trapa nutans). The collections now include about 50% of all endangered vascular plants of the Ussuri flora (mixed conifer-broadleaved zone of South Russian far east) listed in the *Red Book of the Russian Federation*. These are: *Magnolia obovata, Microbiota decussata, Taxus cuspidata, Juniperus sargentii, J. rigida, Rhododendron fauriei, R. schlippenbachii, Pinus densiflora, Aralia cordata, Betula*

schmidtii, Viburnum wrightii, Dioscorea nipponica, Armeniaca manshurica, Quercus dentata, Iris ensata, I. ventricosa, Cypripedium calceolus, C. macranthon, Paeonia lactiflora, P. obovata, etc. This work requires the development of horticultural techniques (e.g. potting compost, seed storage, mycorhiza treatment, pest control). Every year the Garden undertakes expeditions to the South Primorskii Krai, Sikhote-Alin Range, Amur River Basin and Sakhalin Island to collect seed and investigate habitats of native species.

The Garden has two satellite gardens, Blagoveshensk, Amur region and Yuzhno-Sakhalinsk, Sakhalin Island, which significantly widens the scope for growing rare and endangered species, because many plants do not tolerate the climate of Vladivostok. There is a plan to create another satellite garden in Nakhodka, 500 km north of Vladivostok. It is also hoped that the network of botanic gardens in the Russian far east will be enlarged by botanic gardens in Khabarovsk, Magadan and Petropavlovsk-Kamchatskii. The endangered species of the region, including Wrangel Island and South Primorskii Krai can then be held as living collections. Attempts to grow Arctic and Low Arctic plants in Vladivostok Botanic Garden have not been successful.

Another solution is to increase the awareness of local people and encourage endangered species to become fashionable and planted in municipal parks and local private gardens rather than increasing the number of individuals in botanic gardens. Botanic garden staff provide information to the public through popular guidebooks, booklets, articles and offer free advice and planting stock for local residents to grow endangered native plants in their gardens. These taxa will then be conserved in cultivation. Today *Taxus cuspidata, Magnolia, Paeonia*, lilies and *Rhododendron* are grown in urban landscapes, especially around offices and universities in Vladivostok. Far eastern plants are also found in the garden collections of European Russia, Ukraine, Belarus and the Baltic countries. Every year the botanic garden distributes a seed list to 250-

300 organizations which includes endangered native Manchurian plants. For the last three years the number of visitors to botanic gardens has increased several times and reached over 80,000 in 2005. A garden website was created in 2005 and is constantly updated to promote plant conservation.

It is not enough to declare species as endangered and list them in the *Red Book*; their habitats need to be studied, they need to be proactively conserved in nature, propagated in botanic gardens and grown in private collections, gardens, and parks.

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E-mail: algalanin1@yandex.ru
Internet: http://gardens.narod.ru

Above: Local endemic *Microbiota decussata* in the Botanic Garden FEB RAS (Photo: Marina Koldaeva)

Left: Endangered plant *Princepia sinensis* in the Botanic Garden FEB RAS (Photo: Marina Koldaeva)

Top left: Endangered plant *Epimedium macrocephalum* listed in the *Red Book of the Russia Federation* grows naturally in the park area of Botanic Garden FEB RAS (Photo: Marina Koldaeva)

Left: Endangered plant *Fritillaria camtschatcensis* Princepia sinensis

Author: Ri, Wan Ik

Botanic gardens of the Democratic People's Republic of Korea (DPRK)

Above: View of Central Botanical Garden (Photo: Regine Jahn)

The main botanic garden in the Democratic People's Republic of Korea (DPRK) is the Central Botanical Garden built the foot of Mt. Taesong in Pyongyang in 1959 (Secretariat of the CBD, 1998). The DPRK has also built small botanic gardens in every provincial city and near Mt. Paekdu (Samjiyon County, Ryanggang Province) for the conservation of alpine plants. There are other gardens in significant areas of biodiversity such as Mt. Oga (Hwapyong County, Jagang Province) and Ongjin (S. Hwanghae Province Yangdok). In 1998, apart from the Central Botanical Garden, DPRK had 14 provincial botanic gardens, 3 arboreta, and 21 city or County county gardens. An arboretum of 100 ha was being built near the Central Botanic Garden with the aim of preserving 2,500 species through collecting saplings.

The National Biodiversity Strategy and Action Plan of the DPRK states that there are plans to improve their information systems and study the breeding systems of endangered and rare species. In particular the Central Botanic Garden should cultivate rare plants such as *Pentactina rupicola* (Rosaceae), Abeliophyllum distichum (Oleaceae), Echinosophora koreenis (Leguminosae) which are monspecific genera and economic species with high medicinal values. The Action Plan proposes the establishment of a state seed bank in collaboration with the present seed banks for the conservation of the rare species of North Korea.

The Central Botanical Garden (20 ha) is divided into 14 sections which include ornamental plants, economic plants, an orchard, an experimental plot, a tree nursery, a herbarium and a meteorological observatory. It is estimated that about 8,500 plant species are cultivated in the Central Botanic Garden, of which 2,500 species are native. The systematic garden has 480 native trees species and 500 species of herbaceous plants. The medicinal herb garden features exhibits of 500 species of medicinal herbs. The orchard section occupies 2.4 ha and has more than 1,000 trees which grow in Korea and abroad. Among them are Persimmon (*Diospyros* sp.), Hazel (*Corylus*), *Ribes sinanense* and Jujube (*Ziziphus jujuba*). This section will support research for propagating fruit trees of high economic value and enrich the botanic knowledge of working people and schoolchildren. The Central Botanic Garden also grows the Kimilsungia (*Dendrobium* 'Kim Il Sung'cultivars) and Kimjongilia (*Begonia x tuberhybrida* cultivars 'Kimjongilhwa') greenhouses and an orchard of plants which have been given, which forms an "international friendship botanic garden.

There is also a Museum of Botany in the Central Botanical Garden for science and technology with a herbarium which holds 200,000 specimens. The Central Botanical Garden publishes a regular Bulletin. It has established relations with 30 countries to share information. It has published two volumes of the *Flora of Korea, A Reference to trees of economic value, Plants of economic value in our country* and an illustrated book on the Korean Flora which has contributed to the country's botanical development and spread of knowledge about plants.

References

➡ Secretariat of the CBD, 1998. *The National Biodiversity Strategy and Action Plan of the Democratic People's Republic of Korea (DPRK)* Part 1: http://www.biodiv.org/doc/world/kp/kp-nbsap-01-p1-en.pdf accessed, 4 April, 2006.
Part 2: http://www.biodiv.org/doc/world/kp/kp-nbsap-01-p2-en.pdf accessed, 4 April, 2006.

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Book Notices

Biodiversity and the precautionary principle: risk and uncertainty in conservation and sustainable use
Reviewed by Kerry Waylen

The "precautionary principle" means that action to avert serious or irreversible environmental damage may be required before scientific certainty of the harm exists. This may sound like common sense, and it is a common clause in many international laws. However, what does it actually mean for practical conservation? This book is the result of a major project to answer this question, to establish exactly when and how to take action to protect the environment.

The book contains case studies of conservation projects across the world, from Asia to Argentina, to examine experience in application of the principle, its effect on making decisions in the face of uncertainty, and the implications for local livelihoods. It finishes by analysing and summarising the implications and challenges for biodiversity conservation and sustainable use, and includes a useful appendix with summary guidelines for the precautionary principle's application. Working through these chapters, with authors from many perspectives, provides important insight into the principle, and helps to clarify the many challenges and controversies associated with it: for example, the principle should not be used as an excuse for unfair trade restrictions or protectionism.

Implementing the precautionary principle will never be simple, but this book provides valuable support for its application in conservation.

Rosie Cooney and Barney Dickson (eds.), 2005.
Earthscan, London, UK, 314 pp.
ISBN 1-84407-277-0 (Paperback) £22.95,
ISBN 1-84407-276-2 (Hardback) £80.00.
Earthscan, 8-12 Camden High Street, London, NW1 0JH, U.K.,
Tel: +44 (0)1903 828 800,
Fax: +44 (0)2073 878998,
E-mail: earthinfo@earthscan.co.uk,
Internet: www.earthscan.co.uk.

Plant conservation: an ecosystem approach

This is the latest volume in the *People and Plants Conservation Series*. The authors, Alan Hamilton who has worked in many parts of the world as WWF's Plants Officer and now as Manager of the Plant Conservation and Livelihoods Programme at Plantlife International and his son, Patrick Hamilton who is a Research Fellow at the University of Exeter, UK have more than a lifetime's experience of plant conservation.

It provides a fascinating primer on plant conservation which will provide insights to both students and people already working in conservation. It makes no assumptions but thoughtfully describes causes and courses of action with examples which link livelihood support and plant conservation. It has an excellent chapter on the values people place on plants and their uses, which forms a useful foundation for plant conservation with any social group.

It underlines the importance of botanic gardens for research, conservation and education and as centres of information about plants. It includes a good list of references.

Alan Hamilton and Patrick Hamilton, 2006
Earthscan, London, UK, 304 pp.
ISBN 1-84407-083-2 (Paperback) £24.95,
ISBN 1-84407-082-4 (Hardback) £80.00.
Earthscan, 8-12 Camden High Street, London, NW1 0JH, U.K.,
Tel: +44 (0)1903 828 800,
Fax: +44 (0)2073 878998,
E-mail: earthinfo@earthscan.co.uk,
Internet: www.earthscan.co.uk

Beyond extinction rates: monitoring wild nature for the 2010 target

This meeting was organized to develop a process for reporting against the 2010 target for reduction of the current rate of loss of biological diversity which was agreed at the 2002 World Summit on Sustainable Development. It consisted of 19 papers which addressed biodiversity trends for plants and animals. It included a paper on 'Measuring the fate of plant diversity: towards a foundation for future monitoring and opportunities for urgent action' (E. Nic Lughadha, *et al*.: 359-372) which argued that as most biodiversity indices do not include plants focus should be made on major vascular plant families for which there is a taxonomic baseline and assessment of the conservation status of species from these families. It was suggested that this should be done using herbarium specimens in combination with GIS techniques and the existing network of field workers. This would also contribute to target 2 of the GSPC, a preliminary assessment of the conservation status of all known plant species.

Papers of a Discussion Meeting Issue organized and edited by Balmford, P.R. Crane, R. E. Green and G.M. Mace, 2005.
Philosophical Transactions of the Royal Society B *360 (1454)*
These papers are available on the Royal Society Website: http://www.pubs.royalsoc.ac.uk/

Taxonomy and plant conservation: The cornerstone of conservation and the sustainable use of plants
Reviewed by David Galbraith

This is an important volume for anyone concerned with either the conservation of plant diversity or the relevance of taxonomy to non-taxonomist audiences. A festschrift in honour of the 75th birthday of Professor Vernon Heywood, *Taxonomy and Plant Conservation* is a mixture of topics ranging from the relevance of taxonomy to the Convention on Biological Diversity to introductions to the technical and philosophical issues in taxonomy and systematics to detailed case studies of taxonomic and conservation systems, and even some databases and networks. The topical coverage is broad although the geographic emphasis is European. The influence of Heywood's promotion of the role of botanic gardens in conservation and the development of networks, is unmistakable.

Particularly helpful are chapters which directly address the gap between plant taxonomy as a science (where molecular approaches are becoming ever more important and debates rage about cladistics) and use of the products of that science by practitioners in other disciplines who need usability and stability in the names that can be applied to particular organisms. This volume makes admirable efforts to fill that gap.

Etelka Leadlay and Stephen Jury, 2006.
Cambridge University Press, UK, 300 pp.
ISBN 978-0-521-60720-9 (Paperback) £35.00, ISBN 978-0-52-84506-9 (Hardback) £70.00.
Cambridge University Press, The Edinburgh Building, Cambridge CB2 2RU, UK.,
Tel: +44 (0) 1223 326050,
Fax: +44 (0) 1223 326111,
E-mail: directcustserve@cambridge.org,
Internet: www.cambridge.org.

Forthcoming Meetings

August 22 - 26, 2006
EGER, HUNGARY

1st European Congress of Conservation Biology

This meeting is being organised by the European Section of the Society for Conservation Biology to promote the development and use of science for the conservation of European species and ecosystems, and to make sure that conservation policy is firmly underpinned by the best available scientific evidence.
For further information, please contact: http://www.eccb2006.org/

September 10 – 14, 2006
OXFORD, UK

6th International Congress on Education in Botanic Gardens
The Nature of Success: Success for Nature

This meeting is being hosted by the University of Oxford Botanic Garden and organised by BGCI, the University of Oxford Botanic Garden and the Royal Botanic Gardens, Kew.
For information, contact the Education Department, BGCI, Descanso House, 199 Kew Road, Richmond, Surrey, TW9 3BW, U.K.
Tel: +44 (0)20 8332 5953,
Fax: +44 (0)20 8332 5956,
E-mail: educationcongress@bgci.org,
Internet: www.bgci.org/education congress.

September 18 – 22, 2006
PRUHONICE, CZECH REPUBLIC

Fourth European Botanic Garden Congress

For further information please contact Petr Hanzelka, Prague Botanical Garden, Nadvorni 134, 171 00 Prague 7 – Troja, The Czech Republic.
Tel: +420 234 148 111,
Fax: +420 233 542 629,
E-mail: petr.hanzelka@botanicka.cz.

September 25 – 28, 2006
UMAN, UKRAINE

International Scientific Conference ISC 2006
Ancient parks and botanical gardens – scientific centres, biodiversity conservation and protection of historical and cultural heritage

This conference celebrates the 210th anniversary of the foundation the National dendrological park “Sofiyivka”.
For further information please contact the Conference Secretariat:
Miss Galina Vernyuk, ISC 2006, National Dendrological Park “Sofiyivka”, Kievska Street 12/a, Uman, Cherkassy Region, Ukraine, 20300. Tel: +38 04744 38204,
Fax: +38 04744 37294,
E-mail: sofievka@ck.ukrtel.net,
Internet: http://www.sofiyivka.org.ua

March 19 – 23, 2007
SAN JOSÉ, COSTA RICA

3rd International Orchid Conservation Congress

For more information, please contact Jorge Warner,
Email: jwarner@cariari.ucr.ac.cr.

April 16 – 20 April, 2007
WUHAN, CHINA

3rd Global Botanic Gardens Congress
Building a sustainable future: the role of botanic gardens

The 3rd Global Botanic Gardens Congress is being organized by Wuhan Botanical Garden and BGCI. The call for papers has been posted on the website. Please visit the website and register your interest at www.3gbgc.com.

May 22 – 25, 2007
BANGKOK, THAILAND

1st International Biodiversity Congress: Working Together for Livelihood Security, Food Security and Ecological Security for Life on Earth

For details, contact
E-mail: Ram Bhandari
hirinepal@mail.com.np or
ibc2007@yahoo.com

September 5 – 9, 2007
CLUJ-NAPOCA, ROMANIA

5th Planta Europa Conference on the conservation of wild plants in Europe
Working together for Plants

Provisional dates. Pre-registration from May 2006. Conference website to follow:
http://www.plantaeuropa.org/

How to join Botanic Gardens Conservation International

The mission of BGCI is to build a world network for plant conservation. It was founded in 1987 and now includes over 525 member institutions in 115 countries, working together to implement the *International Agenda for Botanic Gardens in Conservation* and the new *Global Strategy for Plant Conservation*.

Institutions can join BGCI for the following benefits:

- Membership of the worldwide plant conservation network
- Botanic Garden Management Resource Pack (upon joining)*
- Regular publications:
  - the regular newsletter, *Cuttings*
  - *BGjournal* – an international journal for botanic gardens (2 per year)
  - *Roots* - environmental education review (2 per year)
  - A wide range of new publications
- Invitations to BGCI congresses and discounts on registration fees
- BGCI technical support and advisory services

	Institution Membership	£ Stlg	US $	€ Euros
A	BGCI Patron Institution	5000	8000	7500
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C	Institution member (budget US$ 1,500,000 - 2,250,000)	440	720	660
D	Institution member (budget US$ 750,000 - 1,500,000)	300	500	440
E	Institution member (budget US$ 100,000 - 750,000)	160	250	220
F	Institution member (budget below US$100,000)*	75	120	110
	**Generally applies to institutions in less developed countries*			

Other Membership Categories:

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- Regular publications:
  - the regular newsletter, *Cuttings*
  - *BGjournal* - an international journal for botanic gardens (2 per year)
  - *Roots* - Environmental Education Review (2 per year)
- Invitations to BGCI congress and discounts on registration fees

	Individual Membership	£ Stlg	US $	€ Euros
J	Conservation donor (*BGjournal*, *Roots* and *Cuttings* plus more)	160	250	220
K	Associate member (*Cuttings* and *BGjournal*)	35	60	50
L	Associate member (*Cuttings* and *Roots*)	35	60	50
M	Friend (*Cuttings*) available through online subscription only (www.bgci.org)	10	15	15

*Contents of the Botanic Garden Management Resource Pack: *The Darwin Technical Manual for Botanic Gardens, A Handbook for Botanic Gardens on the Reintroduction of Plants to the Wild, BGjournal - an international journal for botanic gardens (2 past issues), Roots - environmental education review (2 past issues), The International Agenda for Botanic Gardens in Conservation, Global Strategy for Plant Conservation, Environmental Education in Botanic Gardens, BG-Recorder (a computer software package for plant records).*

Payment may be made by cheque payable to Botanic Gardens Conservation International, or online at www.bgci.org or by VISA/Mastercard sent to BGCI, Descanso House, 199 Kew Road, Richmond, Surrey, TW9 3BW, U.K or Fax: +44 (0) 20 8332 5956.

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This publication is supported through *Investing in Nature* and the Mitsubishi Corporation

Investing in Nature is a partnership between BGCI, Earthwatch, HSBC and WWF

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Printed on 100% recycled paper

ISSN 1811-8712

1st Announcement

3GBGC

3rd Global Botanic Gardens Congress

Building a sustainable future: the role of botanic gardens

Wuhan, China
April 16-20, 2007

Organized by
Wuhan Botanical Garden, CAS
Chinese Academy of Sciences
Hubei Provincial Government
Wuhan Municipal Government
Botanic Gardens Conservation International

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