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THE ROLE OF BOTANIC GARDENS IN IMPLEMENTING THE CONVENTION ON BIOLOGICAL DIVERSITY

With particular reference to Articles 6 & 8

Submission received by the Executive Secretary from the
Royal Botanic Gardens, Kew and
Botanic Gardens Conservation International

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Information document for the third meeting of the Conference
of the Parties of the Convention on Biological Diversity

Agenda item 7.1: Implementation of Articles 6 and 8 of the Convention

THE ROLE OF BOTANIC GARDENS IN IMPLEMENTING THE CONVENTION ON BIOLOGICAL DIVERSITY

With particular reference to Articles 6 & 8

Royal Botanic Gardens, Kew and
Botanic Gardens Conservation International

RBG, Kew and BGCI thank the many botanic gardens world-wide
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INTRODUCTION AND EXECUTIVE SUMMARY

At its second meeting, in November 1995, the Conference of the Parties (COP) of the Convention on Biological Diversity (CBD) requested information and lessons drawn from national experiences on the implementation of Articles 6 (General Measures for Conservation and Sustainable Use) and 8 (*In situ* Conservation) of the Convention. Paragraph 4 (a) of Decision II/7 also requested the Executive Secretary "to compile and disseminate that information as widely as possible, including experience of relevant conventions, United Nations bodies and intergovernmental and non-governmental organisations in dealing with the provisions of Articles 6 and 8".

This paper has been prepared in order to help the Executive Secretary and the COP to implement Decision II/7, Articles 6 & 8, and the other provisions of the CBD. It is based on experience submitted by many botanic gardens.

There are some 1,775 botanic gardens and arboreta in 148 countries world-wide (see Annexe, p. 17). They maintain more than 4 million living plant accessions, representing c. 80,000 species, and manage a wealth of other collections, such as herbaria and seed banks. Their activities in collection, curation, research and conservation contribute significantly to the implementation of the CBD. Botanic gardens are frequently involved in national planning processes such as biodiversity strategies (Art. 6(a)) and their work in other sectors, from agriculture and health to education, enables them to integrate biodiversity issues into other, cross-sectoral plans and policies, as required by Article 6(b).

The use of botanic gardens' collections and the application of their skills in areas such as taxonomy, conservation, propagation and cultivation play an important role in the many activities required by Article 8 (see Table 2, p. 4). Models and mechanisms for links between *in situ* and *ex situ* conservation form an agenda item for next year's COP. Botanic gardens provide a major link between the two.

The provisions of the CBD are closely interconnected. National biodiversity strategies define a range of activities to implement the other Articles of the Convention. Similarly, implementation of Article 8 draws on skills and activities required by other Articles of the CBD. Consequently, this paper also covers not only Articles 6 and 8, but also the other major areas in which botanic gardens are implementing the CBD: principally Articles 7, 9, 10, 12, 13, 15, 17, and 18. These activities are summarised overleaf in Table 1.

For the full potential of botanic gardens' contribution to the CBD to be fulfilled, the following are priorities for action by the Parties to the Convention and botanic gardens themselves:

Umbrella groups of botanic gardens and individual botanic gardens should develop:

- a **'CBD-audit'** or strategic review of the extent to which their current activities implement the CBD and match the Medium-Term Programmes of Work of SBSTTA and COP
- **guidelines** on policies, tools and mechanisms on access and benefit-sharing:
  - ➲ **design a system of CBD-registered botanic gardens**, to facilitate the exchange of genetic resources between gardens able to meet standard criteria on access and the fair and equitable sharing of benefits
- **priorities for capacity building** in areas such as education and awareness; joint research and the feasibility of implementing the proposed CBD guidelines
  - ➲ **launch a 'CBD-aware' initiative by botanic gardens at SBSTTA 3**
- **a botanic gardens clearing-house**, with information by and for botanic gardens.

Parties to the Convention should:

- involve botanic gardens in the development of **national biodiversity strategies**
- include representatives from botanic gardens on **delegations** to SBSTTA, and integrate botanic gardens' views into their **contributions at SBSTTA and COP**
  - ➲ request an improved version of this paper for COP 4, to address COP 4 Agenda items 9 (*in situ/ex situ* linkages), 11 (benefit-sharing), 13 (public awareness), and also 5, 8, 10, 12 & 15
- **provide financial and other support** to botanic gardens in support and recognition of their role in implementing the CBD
  - ➲ **use botanic gardens as early warning centres for threats to biodiversity.**

THE ROLE OF BOTANIC GARDENS IN IMPLEMENTING THE CONVENTION ON BIOLOGICAL DIVERSITY

This paper presents a sample of the current wealth of initiatives through which botanic gardens are contributing to the implementation of the Convention on Biological Diversity (CBD). Basic information on the nature and number of botanic gardens and their collections can be found in the Annexe on page 17, and a summary of their activities implementing the CBD appears below in Table 1.

Table 1. Typical activities of botanic gardens relevant to the Articles of the CBD

Convention Article	Examples of some relevant activities by botanic gardens
6. General Measures	Contribution to national biodiversity strategies and integration of conservation and sustainable use into cross sectoral plans.
7. Identification & Monitoring	Systematics; inventories; monographs; floras; checklists; bibliographies & databases; ecological & GIS surveys; rapid biodiversity assessment.
8. *In situ* Conservation	Protected area, estate and plant population management; habitat restoration.
9. *Ex situ* Conservation	Seed banks; threatened species collections; species recovery programmes; propagation programmes; collections of information and artefacts associated with biological specimens.
10. Sustainable use	Identification and development of economically important species; bioprospecting; horticulture; training & promotion of cultivation; management of trade-related aspects such as CITES; environmental impact assessments.
12. Research & Training	Research and training in: systematics; evolutionary, economic, experimental and ethno- botany; plant anatomy; molecular, genomic and conservation biology; chemistry; biochemistry; ecology; biogeography; *in situ* and *ex situ* conservation techniques; natural resource management; sustainable development policy.
13. Public Education & Awareness	Educational displays and literature; innovative means of raising public awareness; school programmes.
15. Access to genetic resources & Benefit-sharing	Collecting policies and codes of conduct incorporating prior informed consent, collaboration with in-country partners; technology transfer, joint research, capacity building, information and other benefit-sharing; material transfer agreements; indices semina; botanic garden networks.
17. Exchange of information	Taxonomic identification and naming services; sharing of research results; access to libraries and databases; electronic information exchange of biodiversity data between botanic gardens, e.g. BGCI's International Transfer Format for Botanic Gardens Records (ITF).
18. Technical and scientific co-operation	Technology transfer; joint research; the exchange of staff between the herbaria, living collections and laboratories of botanic gardens.

Some activities, such as the development of policies on access and benefit-sharing, are a direct response to the CBD, but others have been conducted by botanic gardens for many years prior to its entry into force in 1993. Many more botanic gardens will develop strategies to implement the CBD as its implications for them become clearer. Ratifying countries are likely to pass on to botanic gardens some of their legal obligations under the CBD.

The important contribution of botanic gardens to the conservation and sustainable use of biodiversity, and the role they can play in the sharing of benefits, place them in a prime position to assist countries by executing the activities required by the Convention. This central role will strengthen and raise the profile of botanic gardens' activities, support their status in the perception of the public and policy-makers, and help them to attract funding for conservation.

GENERAL MEASURES FOR CONSERVATION AND SUSTAINABLE USE (ARTICLE 6)

As an extension of their existing advisory role, many botanic gardens have assisted in the implementation of Article 6 (a) of the Convention, which calls for the development of "national strategies, plans or programmes for the conservation and sustainable use of biological diversity". National strategies enable countries to achieve specific, targeted conservation and sustainable use goals, and to ensure that benefits pass to the most appropriate stakeholders, including botanic gardens (ten Kate, 1995). Strategies can also help to clarify the roles of botanic gardens in relation to the CBD. Article 6 (b) further calls for the integration of "the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans". The scientific research, economic uses and technologies used within botanic gardens can help to integrate biodiversity issues into other areas of policy such as health, science and technology, and land management.

- The Royal Botanic Gardens, Canada (RBGC) was involved from an early stage in the development of the Canadian Biodiversity Strategy (CBS), Canada's response to the CBD. RBGC, along with Environment Canada and McMaster University have now launched a three-year project to develop a national network of institutions involved in plant biodiversity issues. It is planned that this Canadian Botanical Conservation Network will make a significant contribution to the CBS and interact with the international botanic garden community in respect of the CBD.

- The expertise of larger gardens is also being applied to collaborative projects with developing countries, or those without their own gardens, to develop national conservation strategies. The Royal Botanic Gardens, Kew (RBG, Kew), the Overseas Development Agency (ODA), the National Museums of Kenya, and East African NGOs are working towards an East African plant conservation network, with a Plant Conservation Techniques Course funded by the Darwin Initiative. Similarly, RBG, Kew were part of the multi-disciplinary team, funded by the ODA, responsible for the Sustainable Environment and Development Strategy for the Atlantic Island of St Helena.

- In February 1996, the Alexander von Humboldt Institute convened a meeting of Colombian botanic gardens to discuss a national strategy for plant conservation through botanic gardens.

- In July 1992, Kebun Raya, the botanic garden in Bogor, Indonesia, co-operated with the Indonesian Forestry Society, Botanic Gardens Conservation International, Indonesian botanic gardens, and conservation areas, to develop a conservation strategy for Indonesian flora, which represents 10% of the world's flowering plants. The *ex situ* conservation component of the Biodiversity Action Plan aims to strengthen botanic gardens.

IN SITU CONSERVATION (ARTICLE 8)

The Convention emphasises that *ex situ* measures should complement *in situ* conservation. Botanic gardens make an important contribution to both. Illustrative examples of how botanic gardens are implementing each of the subsections of Article 8 appear in Table 2. Reintroduction programmes and the application of skills in propagation and cultivation are a prime example of their role as a linkage between *in situ* and *ex situ* conservation (Eastwood *et al.*, 1995). Studies on seed germination, propagation and reproduction provide the means for developing successful new habitat management practices and techniques for individual species recovery (Akeroyd & Wyse Jackson, 1995). Advances in micropropagation techniques mean that less wild-collected material is needed for reintroduction projects, mitigating threats to ecosystems and *in situ* populations.

Table 2. Botanic gardens and their involvement in *in situ* conservation projects

CBD Article 8	Location	Botanic gardens involved and description of project
(a): system of protected areas	Easter Island, Chile Various	The Chilean National Botanic Garden, the Corporación Nacional Florestal, the Frankfurt Palmengarten, and botanic gardens in Bonn, Gothenburg and Kew aim to establish an Easter Island plant conservation facility to help conserve the national park's endemic species. Over 400 botanic gardens incorporate and manage protected areas e.g. Melbourne, Australia and Sao Paulo, Brazil.
(b): guidelines for protected areas	USA	The Desert Botanical Garden in the Sonora Desert, south-west USA, is developing guidelines for desert restoration, particularly of cacti.
(c): regulate or manage biological resources important for the conservation of biodiversity, within or outside protected areas	Italy, UK Indonesia	Palermo Botanic Garden advises the CITES scientific authority for plants for Italy, and is closely involved in regulating the trade in endangered plant species in Europe. The Royal Botanic Gardens, Kew is the CITES scientific authority for plants for the UK. Staff with expertise on the CBD and access to genetic resources at the Kebun Raya botanic garden are involved in advising Indonesia on its national legislation and procedures for access to genetic resources.
(d): protect ecosystems, natural habitats, viable populations	Madagascar	The Parc Botanique et Zoologique de Tsimbazaza, Madagascar, has collaborated with Missouri Botanical Garden to produce a master development plan for the park, and to bring several native species such as palms under cultivation.
(e): promote sustainable development adjacent to protected areas	Vietnam	The Royal Botanic Gardens, Sydney has seconded members of its horticultural staff to work at the Ba Vi National Park in northern Vietnam to train herbalists from local communities to propagate medicinal plants, thus reducing collections from the Park, and helping to meet the health demands of the growing local population.
(f): rehabilitate, restore degraded ecosystems; recover threatened species	Andalucia, Spain Ecuador	Córdoba Botanic Garden has restored 21 of the 72 taxa of Andalusian flora at greatest risk. Research determines their distribution, numbers and biology, and information on propagation, germplasm conservation, field sampling of potentially cultivable taxa. Restitution in the wild, through introduction, reintroduction or reinforcement, is then carried out. The Jardin Tropical, Esmeraldas, the Charles Darwin Research Station, Galapagos and the botanic garden of the University of Copenhagen are involved in a conservation programme for rare and endangered Galapagos taxa.
(g): regulate...[etc]...risks of LMOs		--- no information currently available ---
(h): prevent introduction of, control, eradicate alien species	South Africa	The National Botanical Institute has helped analyse the history, impacts, management and policies on alien species in South Africa. A project in the fynbos woodland created 6,600 jobs (50% to women), cleared over 33,000 hectares and helped restore water catchment.
(i): compatibility between conservation and sustainable use	Mexico	The Jardin Botanico Clavijero in Xalapa, Veracruz, Mexico runs a project on the sustainable management of CITES listed cycads, involving local farmers in nursery propagation and sale of seedlings, thus removing pressure from the endangered plants *in situ*.
(j): preserve...[etc.]...knowledge, innovations and practices of indigenous and local communities	India	The Tropical Botanical Garden and Research Institute (TBGRI) is developing a medicinal plants conservation programme in Kerala, India, that aims to revitalise local health traditions, and is participating in the All India Co-ordinated Research Project on Ethnobiology, examining the perception of life, culture, tradition and knowledge system of the tribal communities in India. Currently, 9,500 useful plant species have been documented: only 4,000 of these are commonly known to science and many are unknown.
(k): develop ... legislation ... for the protection of threatened species and populations	Europe UK	Botanic gardens from several European countries are members of groups involved in drafting regional legislation such as the Habitats Directive and European Wildlife trade regulations. The Conventions and Policy section of RBG, Kew works on CITES and has recently appointed a Biodiversity Conventions Officer with expertise in access to genetic resources and benefit-sharing. She has worked with botanic gardens, with several countries developing access legislation and was seconded to the Secretariat of the CBD to work on regional and national measures on access and benefit-sharing.
(l): regulate or manage significant adverse effects on biodiversity	Australia	The fungus *Phytophthora* causes die-back, posing a great threat to endangered Australian flora. The Australian botanic gardens conduct research and develop measures to control *Phytophthora*, to stop it spreading, and conserves seeds and plants of wild flora *ex situ*.
(m): co-operate in providing financial support for *in situ* conservation	Various	Botanic gardens have sought funds from bilateral donors. Between 1993-5, collaborative projects including botanic gardens have raised over £1m from the UK Darwin Initiative, alone. Botanic gardens have also raised funds from private sponsors. Kings Park and Botanic Garden, Perth, for example, received Au$230,000 from Western Power to rescue endangered plants. Fifty percent of operational funds for BGCI come from corporate sources. Multilateral donors such as the GEF have financed projects implemented by botanic gardens.

IDENTIFICATION AND MONITORING (ARTICLE 7)

Recommendation II/2 of SBSTTA found "an extraordinary level of agreement that enhanced taxonomic capacity is a sine qua non for the implementation of the Convention". Such taxonomic capacity is found in botanic gardens with herbaria, which are constantly producing and updating inventories, monographs, floras, checklists, bibliographies and databases. These provide comprehensive reviews of selected plant groups at local, regional and global levels and information on conservation status, distribution, ecology, and uses, thus helping to implement Article 7 of the Convention, which deals with the need to identify and monitor the components of biological diversity which are important for its conservation and sustainable use.

- Missouri Botanical Garden (MBG), the National University of Mexico and the Natural History Museum, London are currently producing a seven-volume, Spanish language *Flora Mesoamericana*. MBG are also part of The Madagascar Conspectus Project to produce an annotated checklist and computer database of Malagasy flora in collaboration with the Forestry Herbarium, the Parc Botanique et Zoologique in Madagascar and the Museum National d'Histoire Naturelle, Paris.

- Identification and monitoring may focus on a specific region. The Córdoba Botanic Garden, Spain was established in 1981 and, from the outset, has focused on the protection of the plant genetic resources of its own region, Andalusia. It has since developed an overall strategy for conservation of the Andalusian flora (Hernández Bermejo, Clemente Muñoz *et al.* 1994; cited in Akeroyd and Wyse Jackson, 1995).

Herbarium collections provide both a contemporary and a historical overview of a species or species assemblage. Recently, studies using Geographical Information Systems (GIS) have provided invaluable ecological information such as habitat requirements and changes in range of plant species populations and communities. Where reference collections in herbaria are good enough, it is no longer necessary to collect exhaustively, and possible to use techniques such as rapid biodiversity assessments.

- In an initiative involving the Museum National d'Histoire Naturelle, Paris, the Royal Botanic Gardens, Kew and the Madagascar Protected Areas Authority, GIS is being used to map and reclassify the remaining Malagasy vegetation. The resulting data assist in making recommendations regarding conservation priorities and the siting of reserves.

- Over the last twenty years, the Royal Botanic Gardens, Edinburgh, the University of Brasilia and other collaborators have raised the knowledge and herbarium collections of the *cerrado* vegetation of Brazil from a rudimentary level to the stage where postgraduate Brazilian botanists can use rapid assessment methods, using checklists and conduct quantitative biodiversity assessments within a GIS framework.

Knowledge of biodiversity is an essential pre-requisite for its conservation, so that the science of systematics is a central component to the implementation of the CBD.

- A relatively large proportion of the rare plant species in Australia are only recently described. Staff at botanic gardens there described 153 new Australian species in 1993/4. Of these, 24 (16%) were endangered, vulnerable, rare or probably rare. Such taxonomic research provides a framework of evolutionary relationships by which the conservation significance of different species can be assessed, and an important basis for conservation work.

Equally essential is the identification of processes which have, or may have, adverse effects upon biological diversity (Article 7(c)). Many of the identification and monitoring activities described above help to identify such processes, but assessments of environmental impacts are also a common part of a botanic garden's conservation initiatives *in situ* and *ex situ*. An important part of all such projects is to determine the threats facing the species involved.

- In a meeting in September 1994, the Iberian and Macaronesian Association of Botanic Gardens stressed the importance of controlling processes that can endanger biodiversity. They highlighted the need to control new introductions of plants to avoid genetic contamination, and to adapt laws to prevent genetic erosion through overuse of endemic species as ornamental plants.

- The Royal Botanic Gardens at Peradeniya, Sri Lanka, has monitored the processes endangering local medicinal plants. Unsustainable collection caused the biggest impact, so the Gardens cultivated the plants and passed them to local communities and herbal practitioners.

EX SITU CONSERVATION (ARTICLE 9)

The collections in botanic gardens contain up to one third of the world's flora and represent an unparalleled resource both for conservation and sustainable use. Perhaps 100 taxa survive only in botanic gardens. However, the quality of collections is often low, with little intraspecific genetic representation and high levels of loss and turnover. Improvement of collections is a priority.

Article 9 (a) requires parties to adopt measures for the *ex situ* conservation of components of biodiversity and 9 (b) to establish and maintain facilities for *ex situ* conservation of and research on plants, animals and microorganisms. Both clauses stipulate that such activities should take place "preferably in the country of origin of such components". The living collections, seed banks, herbaria, genebanks and laboratories operated by botanic gardens are key facilities in this regard. While the bulk of botanic gardens are in developed countries, and fewer are located in countries where the majority of biological diversity is found (see Annexe), it is now standard practice for botanic gardens collecting abroad to build the collections in the country of origin by leaving full, duplicate sets of specimens with the local botanical institute or herbarium, and to build their capacity by transferring technology and engaging in joint research (see Art 12, 15 and 18, below). The majority of new botanic gardens have been established in regions of high biodiversity.

Article 9 (c) deals with the recovery and rehabilitation of threatened species and their reintroduction into natural habitats. Botanic gardens have considerable experience in species reintroduction, which lies at the intersection of *in situ* and *ex situ* conservation (see Table 2, Art. 8 (f) for the work of Córdoba Botanic Garden in restoring Andalusian flora). For certain species, cultivated collections can represent much, if not most, of the existing genetic material and are therefore of great importance in species recovery programmes (IUCN, BGCS & WWF, 1989). In 1990, for example, the 13 botanic gardens forming the Dutch Botanic Garden Foundation held material of over one-quarter of all known species of *Opuntia*, *Crassula* and *Agave*. Similarly, the Palermo Botanic Garden, Sicily, grows half of the world's 300 known species of *Opuntia*. Many species of these cacti and succulents are of conservation concern.

- Chile's National Botanic Garden and Corporación Nacional Forestal, the Frankfurt Palmengarten and the botanic gardens in Bonn, Gothenburg and Kew have used genetic "fingerprinting" techniques to identify the species *Sophora toromiro*, extinct in the wild, from their collections and have reintroduced it to Easter Island.

- The Tropical Botanic Garden and Research Institute (TBGRI) in Kerala, South India is involved in the regeneration of economically important rattans through embryo and tissue culture.

- The Royal Botanic Gardens, Hamilton, Canada has an Aquatic Nursery that is the major source for native wetland plants appropriate for habitat rehabilitation and restoration work in Lake Ontario.

Article 9 (d) requires Parties to regulate and manage collection of biological resources from natural habitats for *ex situ* conservation purposes so as not to threaten ecosystems and *in situ*

populations of the species. Botanic gardens' expertise in species population status management and distribution, and in issues such as the trade in endangered species, can help governments to determine appropriate controls for collection, and guide their own activities.

Article 9 (e) encourages Parties to co-operate to provide financial and other support for *ex situ* conservation. Many botanic gardens face severe budgetary challenges, but their important role in implementing the Convention underlines the importance of their financial security. Associations of botanic gardens and individual institutions are raising considerable sums from private institutions and from multilateral agencies such as the GEF and bilateral donors such as the UK's Darwin Initiative.

SUSTAINABLE USE (ARTICLE 10)

Since their early links with medical faculties, botanic gardens have long been involved in developing the sustainable use of plants. Research on economic botany within gardens has helped to identify and develop plants of economic importance, such as foods, plants for use in soil improvement and land reclamation, fuels, essential oils, forages and medicinal plants. Many botanic gardens are involved in testing the efficacy of medicinal plants, in exploring the uses of known chemicals and in prospecting for any new, commercial application for naturally-derived chemicals and genes (see Article 15, below). Several botanic gardens are involved in monitoring domestic and international trade in plants and plant products. Palermo Botanic Garden advises the CITES scientific authority for plants for Italy, and the Royal Botanic Gardens, Kew is the UK scientific authority for plants.

- Established in 1992, Plantas do Nordeste (PNE) is a multidisciplinary collaboration between Brazil's National Council of Scientific and Technological Development (CNPq), 10 universities, governmental research institutes and NGOs in Brazil, and the Royal Botanic Gardens, Kew. The Northeast of Brazil is home to 30% of the Brazilian population and is a major centre of biodiversity, with an estimated 20,000 plant species. PNE works there with local communities to improve knowledge of the region's plant life, strengthen botanical expertise, and apply methods of sustainable management to improve the quality of life. PNE's ten existing projects include a survey to identify and determine the nutritional value of forage plants, evaluation of medicinal plants and living pharmacies, and conservation and sustainable management of high montane habitat in the central Bahian Mountains. Projects are also under development in areas such as sustainable management of fuelwood, training in plant identification, and the sustainable utilisation of native fruits.

RESEARCH AND TRAINING (ARTICLE 12)

Many botanic gardens were established in order to teach botany. The European botanic gardens established in the 16th and 17th centuries were often linked to faculties of medicine, so that botanic gardens have historically been connected to biological and medical research and training for hundreds of years (Juma, 1989). The tradition continues today.

Research within botanic gardens covers a broad range of disciplines, including systematics; evolutionary, economic, experimental and ethno- botany; plant anatomy; molecular, genomic and conservation biology; chemistry; biochemistry; ecology; biogeography, *in situ* and *ex situ* conservation techniques; natural resource management; education techniques; and sustainable development policy. Such research is increasingly conducted in collaboration with partner institutions around the world (see Articles 15 and 18 below).

Botanic gardens are involved in training of an equally interdisciplinary nature. The training can take place either in the course of other activities, such as collection, curation and research, or

within specific training courses. Examples of the former include capacity building and joint research, as set out in Articles 15 and 18 below. Several botanic gardens run training courses, examples of which follow.

- The Capacity Building for Biodiversity Programme at the Royal Botanic Gardens, Kew (RBG, Kew) currently consists of four separate courses, developed in response to specific and continued requests for training by collaborators from all around the world. Since its inception in 1987, RBG, Kew's Herbarium Techniques course has trained 74 professionals from 49 countries in the management of herbaria. The course was run in Russia in 1995 with 25 participants and in Malaysia in 1996 with 22 participants. The Herbarium Handbook has been translated into Russian and Chinese; Japanese and Korean versions are in preparation.

  Instigated in 1993, Conservation Techniques and Botanic Garden Management courses have trained 25 participants from 18 countries and 44 participants from 33 countries, respectively. In collaboration with the National Museums of Kenya, RBG, Kew has started a three year programme funded by the Darwin Initiative on Conservation Techniques in East Africa in 1996, with 15 participants each year. The first International Botanic Garden Education course was run in 1995 with 12 participants from different countries. The second, based in Tasmania, is planned for 1997. A new practical course on Cultivation and Conservation of Threatened Plant Species, funded by the Darwin Initiative, is aimed initially at UK Dependent Territories. Programmes under development include a CITES training course and a programme on practical field techniques for the Tropics.

- BGCI runs training courses world-wide. For example, a Botanic Garden Management course was run in Russia in 1996 with 21 participants. In 1996, the Nanjing Botanical Garden in Jiangsu Province, with support from BGCI and the Darwin Initiative, established an educational programme in Chinese botanic gardens. They also organised a training course for education on environmental science in botanic gardens, attended by more than 18 Chinese gardens. Nanjing is setting up an awareness centre for environmental protection on-site, and hopes the practice will be adopted elsewhere in China.

- The South African Botanic Gardens Network (SABONET) is running herbarium training courses and activities to build the capacity and skills of botanists throughout Southern Africa.

PUBLIC EDUCATION AND AWARENESS (ARTICLE 13)

Over 150 million people, from a wide cross-section of society, visit botanic gardens every year. In an attractive setting, with diverse and frequently exotic collections, gardens can educate the public and raise their awareness on issues related to the conservation and sustainable use of biodiversity. They are well placed to teach about:

- the incredible diversity of the Plant Kingdom;
- the complex relationships that plants have developed with their environment;
- the importance of plants in our lives, economically, culturally and aesthetically;
- the links between plants and local and indigenous peoples;
- the local environment and its global context;
- the major threats that face the world's flora and the consequences of plant extinction;
- how plants grow, and can be cultivated.

As Box 1 on the following page demonstrates, botanic gardens are frequently involved in innovative programmes to educate schoolchildren and adults and to raise awareness within communities.

ACCESS TO GENETIC RESOURCES & BENEFIT-SHARING (ART. 15)

The thrust of the CBD is to ensure that access to genetic resources and the sharing of benefits should consistently be dealt with together. Consequently, while they are explored separately below, this is only to clarify what is meant by each term. *(continued on page 10)*

Box 1. Illustrations of botanic gardens' activities in public education and awareness

- During three consecutive sessions, Selby Botanic Gardens in **Florida** and Lankester Garden in **Costa Rica** *trained* 108 *elementary school teachers* with 20 hours of intensive instruction. The teachers gained a better understanding of Costa Rica's unique biodiversity and the imperative need to protect the remnants of natural forest in the country. Lankester gardens also help some 40,000 foreign ecotourists to learn about epiphytes (including orchids), natural habitats and conservation. Measurements from evaluations indicate a substantial gain in knowledge about the plant conservation mission.

- The alpine garden "La Rambertia", at nearly 2,000 metres in the Rochers-de-Naye above Montreux, **Switzerland**, has developed a new display of *Himalayan plants* from Nepal, Sikkim Kashmir and Tibet. An *education programme* explains the usefulness of alpine flora to fight erosion on uneven ground, the connections between humans, animals, plants, insects, bacteria, soil, water and air, and helps children appreciate their future responsibility for heritage conservation. The Garden has also established a *link with Nepal*. Students from Montreux have begun corresponding with students in Chaurikharka.

- The Royal **Tasmanian** Botanical Gardens conducts an Outreach Programme called the *'Green's Cool Program'*. School children collect seeds from the wild and propagate, plant and care for endangered species in school gardens. This work is linked with classroom and botanic garden studies about ecosystems, environment, biodiversity and conservation. The programme heightens awareness of the plight of species, the need for conservation and provides a real opportunity to take part in plant conservation and environmental repair.

- The botanic garden of the National Autonomous University of **Mexico** has to date organised five *cookery contests*. The aims of the contests were to encourage cooks and housewives to create recipes using Mexican plants and to rescue family knowledge about culinary uses.

- At the **Australian** National Botanic Gardens, Canberra, a ***Bush Food Garden*** has been established. Visitors are encouraged to taste fruits, tubers and roots of the plants and can grind the seeds of grasses such as Kangaroo Grass (*Themeda triandra*) to make flour. This experience is enriched by visitors using traditional tools such as digging sticks, coolamons (bowls) and grind stones. Such activities emphasise the sustainable use of native plants as food sources.

- 'Wotango' is the local name in **Cameroon** for *Prunus africana*. There is a high demand for the bark of the tree, an extract of which is exported to Europe for the production of a drug to regulate prostate gland problems. Companies pay local people on the quantity of bark they present, and Wotango is now heavily endangered. The Limbe Botanic Garden runs *discussion meetings with village communities*, guided tours, slide/video shows and lectures on sustainable use of natural resources, such as techniques in harvesting roots and tree barks. Villagers will now seek licences for the exportation of the tree bark; to contact the Garden and the local forestry department for techniques in bark harvesting; and to check and report any illegal collection. The Garden collects seeds from the wild, and raises and distributes these freely to local people who have initiated community plantations.

- Situated in the heart of the Bronx, the **New York** Botanical Garden (NYBG) runs an innovative outreach programme (*Bronx Green-Up*) to turn some of the borough's 10,000 vacant lots into *community gardens and parks*. Once the City has granted the Garden permission to use plots of land, Bronx Green Up provides lessons in ecology, horticulture and conservation; tools, supplies, plants, seeds and transport; and technical assistance with the physical work of clearing the lots and creating green spaces. Over 1,000 families have now worked with staff, creating 170 neighbourhood gardens. Bronx Green-Up has worked with senior centers, schools, social services, drug rehabilitation facilities, and special education learning centers. NYBG also leads a *compost program* run with the Brooklyn Botanic Garden and the Staten Island Botanical Garden. A demonstration site displays a variety of composting techniques, from the latest technology to creative home-made devices such as stacked old tyres.

- Demand for guided visits in the Botanical Garden of the National University of **Mexico** has outstripped supply. The garden has designed a series of *portable educational packs* so that school teachers can guide their own classes independently. Each educational pack includes original plant materials and processed products, accompanied by text and illustrative aids (e.g. slides, drawings). The topics currently covered are: flowers, seeds, fruits, candies, medicinal plants and spices and condiments. Printed material includes a manual, a set of flip charts, a glossary of scientific terms, a list of activities, a set of slides and a recommended bibliography. Special emphasis is placed on botanical information related to cultural history in order to show the children the importance of their rich and long-lived cultural heritage, as well as the necessity of the diverse biological resources in Mexico. This system has been used in both urban and rural settings.

Source: BGCI and Royal Botanic Gardens, Kew

Access to genetic resources

In the context of botanic gardens, two kinds of access to genetic resources are relevant: (a) access by botanic gardens to genetic resources as defined in Article 15, and (b) access by others to the collections of botanic gardens, which frequently lie outside the provisions of the CBD on access and benefit-sharing (ten Kate, in press).

(a) Access by botanic gardens to genetic resources

Historically, botanic gardens' expertise in economic botany gave them a prominent role in gaining access to the plant genetic resources that formed an important economic basis for expanding colonies (Juma, 1989). Subsequently, there has been a trend towards recognition of provider countries' sovereign rights over genetic resources, and the rationale for sharing benefits. Since the entry into force of the CBD, it has been clear that the authority to determine access to genetic resources rests with national governments, and that such access should be subject to the prior informed consent of the provider and on mutually agreed terms (see UNEP/CBD/COP/3/20). Botanic gardens gain access to genetic resources through two principal means: collecting expeditions, and exchange of specimens.

Collecting expeditions: Botanic gardens involved in collecting activities need to comply with national legislation of the country where they are collecting. Since the language of the CBD is open to interpretation and leaves considerable discretion to individual countries, and since access legislation is non-existent or unclear in many countries, it is often a question of implementing the spirit rather than the letter of the law. In this respect, botanic gardens can adopt or adapt Codes of Conduct for Collection. Several such codes have been developed by professional societies and local and indigenous communities (e.g. Posey & Dutfield, 1996). Individual botanic gardens have also developed policies binding on their staff. The Royal Botanic Gardens, Kew is developing a Code of Conduct for Collection and Collaboration (Box 2) and Missouri Botanical Garden has a Natural Products Research Policy which covers the terms of collection (see WWW site at <http://www.mobot.org>).

Box 2. Elements of a potential code of conduct for collectors

- PRIOR INFORMED CONSENT: Collectors should seek the prior informed consent of government and local stakeholders for access, use, and publication of genetic resources and associated knowledge based on full disclosure of proposed activities and subsequent use of biological materials.
- PREPARATION IN ADVANCE: Collection should be based on knowledge of the characteristics, distribution and environmental vulnerability of the species to be collected, their ecosystems and their social and cultural significance. Collectors should be aware of and comply with international, regional, national and local legislation and policy related to the use of biodiversity, and apply well in advance for the relevant consents and permits.
- COLLABORATIVE PLANNING: Collectors should collaborate as closely as possible with host country organisations and stakeholders to design, plan and conduct the activities in such a way as to contribute to the host country's environmental, economic and social goals. Together, they should identify institutional mechanisms through which results and benefits can be channelled.
- AGREEMENT ON TERMS AND BENEFIT-SHARING: Collectors should do their best to ensure that the terms of the access agreement provide for the fair and equitable sharing with the host government and stakeholders of the results of research and development and the benefits arising from the commercialisation and utilisation of the materials.
- SUSTAINABLE USE; SOCIAL AND ENVIRONMENTAL IMPACT: Collectors should do their best to ensure that collecting activities promote the conservation and sustainable use of biodiversity, and cause no adverse environmental or social impact.

Source: K. ten Kate, 1996, Royal Botanic Gardens, Kew

Exchange of genetic resources: For many years, botanic gardens exchanged seeds, living plants and herbarium specimens through an informal system of exchange among collaborating scientific institutions. Together with other institutions, botanic gardens would request seeds from the lists published by individual botanic gardens (*Index Seminum*). Recently, however, a growing awareness of the requirements of the CBD on access to genetic resources and benefit-sharing, and of the potential interest of recipients of botanic gardens' materials in biodiversity prospecting, has resulted in changes in policy in many botanic gardens. A growing number of gardens have now adopted official policies in respect of benefits from bioprospecting and the transfer of plant material.

Conditions upon which botanic gardens gain access to genetic resources will differ according to the use to which the garden, or any subsequent recipient, may put the sample. Some botanic gardens collect only to further scientific work, but may later provide the materials in their collections to third parties. Others collect with commercial applications such as bioprospecting in mind.

- At Missouri Botanical Garden (MBG), specimens collected as part of the garden's research programmes are for non-commercial purposes only and are not available for commercial exploitation. Separate collection of samples for biological prospecting occurs only when a number of conditions, including prior informed consent, are met, as set out in the Missouri Natural Products Research Policy. MBG also maintains a DNA bank, the material in which is solely for the purpose of supporting molecular phylogenetic studies. Samples are not available for any commercial applications such as bioprospecting or screening for genes, and all material is released under the conditions of their Material Transfer Agreement.

- The Royal Botanic Gardens, Kew collects in collaboration with in-country partners, for scientific purposes only, and not for bioprospecting. However, subject to prior informed consent and conditions of access accorded by the country of origin, Kew may supply material from its collections to third parties. This is always under a material transfer agreement that requires fair and equitable benefit-sharing. Generally, materials are supplied on condition that they are only to be used for non-commercial purposes, but where potential recipients state their wish to screen plant materials, a more elaborate contract is signed, which stipulates in more detail the sharing of benefits with the provider country authorities and institutions.

(b) Access to the collections held by botanic gardens

Post-CBD collections: Botanic gardens not only gain access to others' genetic resources, but make their own collections accessible to third parties. Collections by botanic gardens will increasingly be obtained on conditions that require the sharing of benefits, triggered by the prior informed consent procedure incorporated in national access legislation or permitting systems referred to in Section (A). Such conditions will affect the basis upon which botanic gardens can make their material in their collections available to others. Provider countries may prefer to supply potential recipients directly, rather than via a botanic garden, or may require the botanic garden to secure undertakings from recipients to share benefits with the provider country (see MTAs, below).

Pre-CBD collections: The vast majority of botanic garden collections, some four million accessions, pre-date the Convention (BGCI database). The effect of Article 15(3) of the CBD is to exclude such genetic resources from the prior informed consent and benefit-sharing provisions of the Convention. The Convention itself thus places botanic gardens under no obligation to secure the prior informed consent of the countries or stakeholders which provided these resources before commercialising them or passing them to third parties, nor to share benefits with them. National access legislation may, however, do so (Comisión del Acuerdo de Cartagena, 1996 and UNEP/CBD/COP/3/20), and botanic gardens may opt to do so voluntarily. Despite the challenges in doing so, the Royal Botanic Gardens, Kew intends to share any benefits that arise from present or future use of its collections, even if these were

acquired prior to the entry into force of the Convention. Kew is also happy to make available to countries of origin information on the biological activity it has discovered through its in-house research on their plants, even those acquired before the Convention. Other gardens are also believed to be exploring option for retrospective benefit-sharing.

Gardens with benefit-sharing policies generally require Material Transfer Agreements (MTAs or Plant Distribution Agreements) to be signed prior to the despatch of plants or plant-derived material. Common terms in MTAs include:

1. Material to be used for the common good in areas such as research, education, conservation and the development of botanic gardens.
2. Commercialisation of genetic material or derived products requires written permission from the botanic garden and usually involves a separate agreement.
3. Materials must not be passed to a third party without permission.
4. Any research publications resulting from the use of the material must acknowledge the botanic garden.

For example, the Royal Botanic Gardens at Edinburgh, Sydney and Kew use material transfer agreements containing such terms. The Chelsea Physic Garden, London (CPG) issues an *Index Seminum* and Affidavit form in English, French and Spanish, containing such terms. Several organisations recognise the need to develop more sophisticated agreements that fully integrate prior informed consent and stipulate benefit-sharing obligations to countries of origin. Both Edinburgh and Kew are reviewing their agreements, and CPG is in the process of revising its documentation to address the requirement for prior informed consent. BGCI has formed an international working group to develop policies and tools on access and benefit-sharing for botanic gardens.

Many bioprospecting contracts place the onus of sharing benefits with the source-country of the plants onto the botanic garden. Companies also expect botanic gardens to have secured prior informed consent. Currently, few botanic gardens have reviewed their collection, release and bioprospecting policies to see whether they implement the provisions of the CBD, and few are expert in benefit-sharing, bioprospecting markets and partnerships, or the full implications of a role as a broker. Furthermore, no estimates of transaction costs have been conducted to review the investments in human, institutional and financial resources needed for a botanic garden to design and implement such policies. Altogether, this poses a major challenge to botanic gardens.

Box 3. A voluntary system of registered botanic gardens implementing policies on access and benefit-sharing pursuant to the Convention on Biological Diversity

The CBD's provisions on access and benefit-sharing are binding only on Contracting Parties, and only cover genetic resources acquired after the CBD's entry into force. Botanic gardens are often private organisations which own their collections, and over 90% of these pre-date the CBD. The power of governments to regulate the acquisition and supply of materials owned by the private sector is limited. A voluntary system is needed. A simple, flexible and transparent system of registered botanic gardens could clarify institutions' policy, facilitate "fast-track" access, promote benefit-sharing, resolve the anomalous status of pre-CBD collections and lower transaction costs.

Botanic gardens that developed transparent standards of best practice would be viewed favourably by national authorities granting access. Gardens prepared to adopt and implement specific, standard policies on access and benefit-sharing could enjoy other benefits such as "fast-track" exchange with other gardens, and lower transaction costs, using umbrella material transfer agreements instead of numerous individual agreements. A few gardens could operate such a system informally. Alternatively, each Contracting Party could set up a national system of CBD-registered institutions analogous to CITES-registered institutions.

Source: K. ten Kate, 1996, Royal Botanic Gardens, Kew

Benefit-sharing

Benefits come in many different forms, but fall into two principal categories: monetary and non-monetary. The financial value of the non-monetary benefits - such as equipment, training and licenses to use technology - may often outstrip the value of monetary benefits.

Monetary benefits

These include collection fees, research budgets and shares in any royalties that result from the successful commercialisation of samples. Botanic gardens involved in collecting specimens in other countries are accustomed to paying permitting authorities a modest, one-off fee to process the application, enter protected areas, and cover overheads. However, unlike commercial entities, few botanic gardens collecting in their own right can afford to pay a fee per sample, or to contribute a research budget to an in-country institution in exchange for access to genetic resources.

Botanic gardens with benefit-sharing policies generally stipulate that they will share any royalties that arise. Their policies rarely clarify which uses trigger this obligation, how royalties are calculated, or what the share will be, although the Royal Botanic Gardens, Kew, the New York Botanic Garden, and the Tropical Botanic Garden and Research Institute, Kerala, work on the basis of sharing 50% of royalties received with collaborating institutions.

Royalties arise only in the context of bioprospecting. Relatively few botanic gardens are involved in such activities, and very little of the work of those gardens that are relates to bioprospecting. The vast majority of samples collected by botanic gardens will be used in taxonomic studies and conservation work alone. In bioprospecting, the probability that any specimen collected will result in a commercial product is very low. Consequently, the most realistic benefits that the botanic garden community can offer in exchange for access to genetic resources - and frequently the most sought-after by collaborators - are non-monetary.

Non-monetary benefits

These include provision of samples, access to other genetic resources in exchange, transfer of technologies or licenses to use them, information, training, joint research, and exclusive crop or product development rights. Perhaps the most important component of benefit-sharing is capacity building, which enables countries better to conserve and add value to their biodiversity. The role of botanic gardens in capacity building is dealt with under the section on "Research and Training", above. Technology transfer and joint research are dealt with in "Technical and Scientific Cooperation", below.

It is standard practice among botanic gardens - and generally required by countries' permitting and access systems - for duplicate specimens and all field information related to them, to be left in the country in which collection takes place. Other categories of information exchanged are dealt with under Article 17, below. Another method of sharing benefits with collaborators can be to exchange accessions, to complement collections and boost the genetic diversity within each collection.

- The Royal Botanical Gardens, Hamilton in Canada worked with the St. Vincent Botanic Gardens in the Caribbean and various sponsors to provide signs and labels for its collections, an initiative that was later expanded to areas of *in situ* conservation in St. Vincent.

- Missouri Botanical Garden has purchased microscopes and other equipment for the University of Ghana and the National Herbarium of Tanzania, and provided collaborating institutions with collecting equipment and botanical references.

- BGCI has made plant collections data management software available to over 250 botanic gardens.

- The Jodrell Laboratory of the Royal Botanic Gardens, Kew has provided know-how on phytochemical and biological screening methods to scientists from Tunisia, Costa Rica, Sri Lanka, India, Kenya and Brazil.

EXCHANGE OF INFORMATION (ARTICLE 17)

Botanic gardens exchange information relevant to the conservation and sustainable use of biodiversity through research and training, education and awareness raising, and benefit-sharing (see Articles 12, 13 and 15, above). Such information includes the results of research, publications, information held on databases and unpublished literature. Botanic gardens have extensive libraries and databases that are accessible, on different terms, to researchers, members of the public and countries providing collections. Major botanic gardens with herbaria provide a service identifying and naming plants sent in for this purpose by researchers world-wide.

- Missouri Botanical Garden (MBG) repatriates project data in electronic form to all participating institutions, especially when it promotes equitable sharing of information from collections that predate the Convention. Numerous data sources are available via the MBG WWW Site at <http://www.mobot.org>, including Floras, papers, checklists, gazetteers and the TROPICOS nomenclatural database, which contains information on some 750,000 taxa. Recently, over 47,000 records have been transferred from TROPICOS to Ecuador's new National Biodiversity Database, which is to be coupled to a GIS.

- The Survey of Economic Plants for Arid and Semi-Arid Lands (SEPASAL) is a major economic botany database of useful plants of drylands and is developed and maintained at RGB, Kew. It includes c. 6,000 species and contains data on ecology, distribution and usage, drawing together existing literature and acting as a clearing-house on traditional and scientific knowledge.

- The *International Transfer Format for Botanic Gardens Records* (ITF), was prepared in 1987 by Botanic Gardens Conservation International (BGCI) as an internationally agreed standard format for such data exchanges. ITF is available in English, French and Chinese, and assists the electronic transfer of data on living plant collections between institutions. Compatibility with the ITF has now been included in the major botanic garden living collection data management systems world-wide. Regular data transfers are now occurring between botanic gardens and the international monitoring database maintained by BGCI. A second version of the ITF will be published in 1997. BGCI has used the ITF to monitor the conservation collections of botanic gardens world-wide by identifying priority taxa in cultivation in comparison to the global threatened plants list maintained by the World Conservation Monitoring Centre. The BGCI database contains records in cultivation in 374 botanic gardens representing a total of 10,399 endangered taxa and 13,484 non-threatened taxa. The data gathered on rare and threatened plants by BGCI are confidential. Sensitive information concerning these plants or their origins are not released to any third party, without the express permission of the suppliers of the data.

TECHNICAL AND SCIENTIFIC COOPERATION (ARTICLE 18)

It is now standard practice for botanic gardens to co-operate with in-country partners on collection, curation and research. Prime means for doing so include the provision of information such as research results, the transfer of technologies such as know-how, methodologies for the study and use of plants and screens for bioprospecting, and the exchange of staff between the herbaria, living collections and laboratories of botanic gardens. When commercial products have resulted from resources supplied by botanic gardens, another form of benefit-sharing that can be negotiated for countries of origin is a licence to

use technology developed from their genetic resources in the country, or the right to develop crops and supply raw or processed materials for scaled-up production.

- The Rancho Santa Ana Botanic Garden at Claremont, California, has entered into joint research agreements with the Universidad Autonoma del Estado de Morelos in Cuernavaca, Mexico, which has established a 31,000 hectare conservation area. Environmental education and conservation programmes entail the active exchange of staff and students from each institution.

- Chelsea Physic Garden (CPG) is collaborating with Universiti Pertanian Malaysia to develop a medicinal plant garden there. As well as horticultural advice and training of local staff, a staff exchange of CPG's education officer will assist in the site interpretation and public education aspects. The garden will provide raw material for *in situ* screening. It will also emphasise the importance of local biodiversity to visitors.

- RBG, Kew conducts joint research with around 300 institutions. Staff may be exchanged, on secondment or sabbatical. Liaison botanists from countries such as India, Australia and Malaysia work in the Herbarium. Fifty PhD and 50 other students from collaborating institutions work at Kew each year. The Plantas do Nordeste (PNE) project in Brazil has involved 12 Kew botanists working in Brazil and 20 Brazilian staff at Kew. There are 55 research students registered with PNE in Brazil, and approximately 50 other Brazilian staff are involved. Kew is involved in assessing the biological activity of plants in collaboration with 128 institutes. Kew, the British Technology Group (BTG) and INBio collaborated to develop a nematocide from a Costa Rican tree. BTG has granted INBio a licence to develop this product.

CONCLUSIONS AND RECOMMENDATIONS

Botanic gardens are contributing significantly to implementation of the CBD. Their efforts to date, however, have been *ad hoc*, with more progress on conservation and sustainable use than on the fair and equitable sharing of benefits. For the full potential of botanic gardens' contribution to the CBD to be fulfilled, there are priorities for further action by the Parties to the Convention and by botanic gardens themselves:

Umbrella groups of botanic gardens and individual botanic gardens should:

1. **develop a 'CBD-audit'** or strategic review of the extent to which the current activities of botanic gardens implement the CBD and meet the priorities of the Medium-Term Programmes of Work of SBSTTA and the COP.

2. **prepare and implement guidelines** on policies, tools and mechanisms on access and benefit-sharing:
   - collections strategies that meet collaborators' needs, including prior informed consent and appropriate conditions for acquiring botanical collections
   - codes of conduct for collection and collaboration
   - policies and conditions for supplying materials, including material transfer agreements
   - mechanisms and partnerships for delivering benefits to stakeholders

   ➲ **design a system of CBD-registered botanic gardens**, to facilitate the exchange of genetic resources between gardens able to meet standard criteria on access and the fair and equitable sharing of benefits.

3. **undertake priority tasks in capacity building,** in areas such as:
   - education of botanic garden staff and public awareness raising of the CBD

     ➲ launch a **'CBD-aware' initiative by botanic gardens at SBSTTA 3**
   - joint research
   - feasibility and transaction costs of implementing the above CBD guidelines.

4. **develop a botanic gardens clearing-house,** identifying contributions of information:
   - by botanic gardens for use in the pilot phase of the clearing-house mechanism, and
   - available through the clearing-house to assist botanic gardens implement the CBD.

Parties to the Convention should:

1. involve botanic gardens in the development and implementation of **national biodiversity strategies.**

2. include representatives from botanic gardens on **delegations** to SBSTTA, and integrate botanic gardens' views into Parties' **contributions to SBSTTA and COP**

   ➲ request an **improved** version of this paper for COP 4, to address COP 4 Agenda items 9 (*in situ/ex situ* linkages), 11 (benefit-sharing), 13 (public awareness), and also 5, 8, 10, 12 & 15.

3. provide financial and other support to botanic gardens in support and recognition of their role implementing the CBD, especially:
   - identification, monitoring and assessment of components of biodiversity

     ➲ **develop a scheme to use botanic gardens as early warning centres for threats to biodiversity**
   - providing an important link between *in situ* and *ex situ* conservation
   - raising public awareness of biodiversity and its significance.

ANNEXE. AN OVERVIEW OF BOTANIC GARDENS

The *Botanic Gardens Conservation Strategy* (IUCN-BGCS & WWF, 1989) lists the defining characteristics which may be met, in part or whole, by an institution that is considered to be a botanic garden. Botanic garden collections are grown and maintained for a number of educational, economic, medicinal or scientific purposes. In addition to the living collections, many botanic gardens have associated herbaria and other research facilities. The many and varied roles of botanic gardens include, *inter alia*:

- Wild plant species research conservation and management (*ex situ* and *in situ*)
- Plant reintroductions and habitat restoration research
- Arboriculture
- Library services and information centres
- Environmental education programmes for children and adults
- Teacher training
- Tourism
- Public recreation
- Horticultural research
- Ornamental horticulture and floriculture
- Horticultural training
- Remedial training and therapy
- New crop genetic resource introduction and assessment
- Cultivar conservation and maintenance
- Seed banking
- Field genebanks
- Herbarium studies
- Laboratory research, including *in vitro* (tissue culture) plant cultivation
- Ethnobiological research
- City and town planning, resource allocation and land use

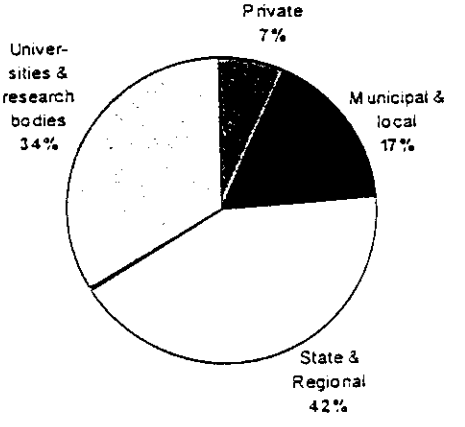
Types of botanic gardens

Although most botanic gardens defy stereotyping, a number of general categories can be recognised:

- "Classic" multi-purpose gardens
- Ornamental gardens
- Historical gardens
- Medicinal gardens
- Conservation gardens
- University gardens
- Botanical/Zoological gardens
- Agro-botanical and germplasm collection gardens
- Alpine or mountain gardens
- Sanctuary gardens
- Native plant gardens
- Horticultural gardens
- Generic or family gardens

Status of botanic gardens

Botanic gardens are managed by a range of organisations and administrations (see figure, right). The majority are state-administered, or managed by regional or local authorities, and receive public funding. Almost as many, however, belong to universities and other research establishments and institutes for higher education. A relatively small proportion are private. In recent years the trend has been for botanic gardens to gain greater financial and administrative independence, often becoming trust-administered and operating with cash gained increasingly through independent fund-raising efforts.



Distribution of botanic gardens

There are 1,775 known botanic gardens and arboreta in 148 countries world-wide. Global distribution is uneven, however, with the majority of botanic gardens in the temperate world and particularly Europe, North America and the countries of the former Soviet Union. The botanic gardens in these regions also contain the largest collections.

Many parts of the world that are richest in biological diversity have relatively few botanic gardens. These include Brazil (29 botanic gardens); Colombia (13); Ecuador (4); Indonesia (5); Madagascar (1); Peru (7) and Zaire (2). This compares unfavourably with the total number of botanic gardens in countries such as France (68), Germany (78), Japan (54), Russia (76), the UK (66) and the USA (285). Nevertheless, it is in developing or tropical countries that the greatest number of new botanic gardens are being proposed or established.

Botanic garden collections

It is estimated that botanic gardens world-wide maintain more than 4 million living plant accessions, representing c. 80,000 species (BGCI database). The best-represented plant groups in these collections include carnivorous plants; orchids; palms; cacti and other succulents; woody legumes; ferns; cycads; bulbous plants; bromeliads; and conifers. Many botanic gardens grow and maintain thematic collections of plant groups such as medicinal and aromatic plants; economic plants (particularly fruit trees and their wild relatives); ornamentals; plants of ethnobotanical or historical interest; alpines; and trees. The floras of Europe, North America, temperate South America and Asia, Australasia, and South Africa are particularly well-represented, as are the endemic floras of many oceanic island groups such as Macaronesia, the Mascarene Islands and Hawaii. As much as 30% of the rare and endangered flora of these regions is in cultivation in botanic gardens. The floras of many major tropical and sub-tropical continental countries, however, are currently poorly represented in botanic garden collections.

Numerous botanic gardens are replacing unlocalized plant accessions with newer material of known wild origin and giving higher priority to maintaining genetically diverse collections of rare or endangered plant taxa. There is also an increasing trend for botanic gardens to give priority to the cultivation of the native flora of their own region, particularly those that are threatened.

Botanic garden networks and linkages

The development of networks of closely co-operating botanic gardens has been instrumental in their growth over the last two decades. The International Association of Botanical Gardens (IABG) was established in 1954, and was the first global network organisation for botanic gardens and arboreta. The IABG aims to promote:

- international co-operation between botanic gardens, arboreta and similar institutes maintaining scientific collections of living plants;
- the study of taxonomy of plants to benefit the world community;
- documentation and exchange of information, living plants and specimens between botanic gardens and similar institutes;
- the conservation of plants through cultivation and other means within botanic gardens and similar institutes;
- the introduction to cultivation of appropriate plants of benefit to the community;
- habitat conservation by co-operation between IABG and other relevant bodies;
- horticulture as an art and science.

Botanic Gardens Conservation International (BGCI) is the global network of botanic gardens working for biodiversity conservation. It has over 450 members in 100 countries and maintains regional offices in China, Colombia, The Netherlands, Indonesia, Russia and Spain, as well as its UK headquarters at Kew. BGCI co-produced *The Botanic Gardens Conservation Strategy* in 1989, and has since published a series of technical manuals and handbooks for botanic gardens on such subjects as plant reintroductions, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), environmental education and computer database development. Forthcoming publications will include plant conservation techniques, collections policies, plant material transfers policies and a technical manual for botanic gardens. BGCI has undertaken technical training initiatives for botanic gardens in several countries, especially in the fields of environmental education and biodiversity conservation. Recent work has included development plans for new botanic gardens, and conservation projects in countries including Barbados, Haiti, Laos, Morocco, Russia, Tunisia and Vietnam.

The American Association of Botanical Gardens and Arboreta (AABGA) acts as an umbrella organisation for North American public gardens and is increasingly considering biodiversity conservation as part of its mission. The Center for Plant Conservation (CPC), based at the Missouri Botanical Garden, St Louis includes over 20 leading gardens and manages a national collection of rare and endangered native plants conserved *ex situ.*

Other regional and national networks of botanic gardens exist world-wide and are too numerous to list. Although such networks arose from diverse origins, there is now close co-operation and effective operational links between them. Formal co-operative agreements or memoranda of understanding have been signed by BGCI with other major organisations including IABG, AABGA and IUCN - The World Conservation Union.

Growth of botanic gardens

The last twenty to thirty years has seen a considerable development in botanic gardens world-wide: approximately 25% of the botanic garden member institutions of BGCI were established since 1980. The majority of newly established botanic gardens or redeveloped older botanic gardens are situated in developing countries or in regions of high plant diversity. There has also been a corresponding rise in botanic garden involvement in research and conservation of the floras of the regions or countries in which they are situated. The traditional role of botanic gardens in *ex situ* conservation has also broadened considerably. Many gardens are taking a more integrated approach to the conservation of biological diversity, enhancing their involvement in *in situ* plant conservation through habitat management and restoration, wild population management, and by environmental advocacy, taxonomic research, exploration and environmental education.

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