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The individual applications of botanic gardens for plant conservation in temperate areas

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ABSTRACT

WYSE JACKSON, P. S. (1993). The individual applications of botanic gardens for plant conservation in temperate areas.

Comptes-rendus du colloque "Nature et Jardins botaniques au XXI^e siècle", Genève, 2-4 juin 1993. *Boissiera* 47: 40-48.

The majority of the world's botanic gardens are in temperate regions, mainly in Europe and North America. Although the biodiversity of the temperate parts of the world is lower than that of the tropics, there is still major action required by botanic gardens in many temperate countries if substantial losses of important plant diversity are to be avoided. Many of the 500 + European botanic gardens have been amongst the first gardens to become heavily involved in plant conservation. Despite this, as little as 31% of the European threatened flora is presently known to be in cultivation in botanic gardens and their much greater involvement in the conservation of local floras is required.

The individual roles of botanic gardens for plant conservation are varied and are outlined in The Botanic Gardens Conservation Strategy. Many European institutions are large and well supported and staffed. Some have excellent research facilities including herbaria, field stations, libraries and laboratories as well as very significant living collections of native and exotic plants. The potential to increase their activities in plant conservation is therefore great, especially if they can link their activities with national and international priorities and work alongside non-garden agencies and institutions active in their own countries and regions. Developing an individual institutional response to The Botanic Gardens Conservation Strategy should be seen as a high priority for each garden so that they can make best use of their resources for biodiversity conservation.

The involvement of botanic gardens in plant conservation is set to expand in future years well beyond their traditional and continuing role in ex situ conservation. Already, they have become increasingly important for environmental education and in raising public awareness of plant conservation issues. International co-operation between botanic gardens, especially for staff training and exchange, is also crucial. However, many more botanic gardens than are presently active must further develop themselves as multi-purpose resource centres for plant conservation if important plant resources are not be

lost. Greater involvement by botanic gardens in initiating, supporting and implementing broadly-based plant conservation actions and species recovery plans will be vital, with greater emphasis given to the conservation of their local plants.

RÉSUMÉ

WYSE JACKSON, P. S. (1993). Modes individuels des jardins botaniques pour la conservation des plantes en zones tempérées.

Comptes-rendus du colloque “Nature et Jardins botaniques au XXI^e siècle”, Genève, 2-4 juin 1993. *Boissiera* 47: 40-48.

La majorité des jardins botaniques dans le monde sont situés dans des régions tempérées, principalement en Europe et en Amérique du Nord. Bien que la biodiversité des parties tempérées du monde soit plus faible que dans les régions tropicales, les jardins botaniques dans de nombreux pays tempérés se doivent de prendre des mesures, si l'on veut éviter des pertes substantielles de diversité des plantes. Nombreux sont les jardins botaniques parmi les plus de 500 qui se trouvent en Europe à avoir été les premiers à se consacrer à la conservation des plantes. Malgré cela, seulement 31% de la flore européenne menacée est à l'heure actuelle cultivée dans les jardins botaniques et il est impératif de se vouer davantage à la conservation de la flore locale.

Les rôles individuels des jardins botaniques pour la conservation des plantes sont variés et font l'objet d'une description dans la Stratégie pour la conservation des Jardins botaniques. De nombreux instituts disposent de grands moyens financiers et de personnel. Certains sont pourvus d'excellentes installations de recherche, y compris herbiers, antennes sur le terrain, bibliothèques, laboratoires ainsi que de très importantes collections vivantes de plantes natives et exotiques. Par conséquent, le potentiel pour augmenter leurs activités en matière de conservation des plantes est large, tout particulièrement s'ils peuvent lier celles-ci avec des priorités au plan national et international et travailler en parallèle avec des organismes et des instituts non-botaniques dans leur propre pays ou région. Le développement d'une réponse individuelle de la part de chaque institut à la Stratégie pour la conservation des Jardins botaniques devrait figurer comme une priorité importante de chaque jardin, de façon à ce qu'ils puissent pleinement utiliser leur ressources pour conserver la biodiversité.

Dans les années à venir, les jardins botaniques seront de plus en plus concernés par la conservation des plantes, bien au-delà de leur rôle traditionnel et continu de la conservation ex-situ. D'ores et déjà, ils sont devenus très importants en matière d'éducation environnementale et dans la sensibilisation du public aux aspects de la conservation des plantes. Il apparaît également crucial de promouvoir une coopération internationale entre les jardins botaniques, notamment pour favoriser la formation du personnel et les échanges. Toutefois, un plus grand nombre de jardins botaniques doit se développer en centres de ressources polyvalents pour la conservation des plantes, si l'on veut éviter des disparitions de plantes substantielles. Il est vital que les jardins botaniques s'impliquent plus dans l'initiation, le support et la mise en place d'actions d'envergure de conservation de plantes et de sauvetage d'espèces, en mettant l'accent sur la conservation des espèces locales.

Introduction

This paper focuses on the present and likely future roles in plant conservation for botanic gardens in temperate regions, particularly in Europe. It gives a personal view of what should become their top priorities for the coming decades.

The latest count of botanic gardens for the whole of Europe, east and west, gives a total of 533 botanic gardens (BGCI, unpubl. and HEYWOOD & al., 1990). This is one-third of the world's total, almost 1,600. In the last few decades the roles and activities of many botanic gardens have changed dramatically to respond to increasing demands put upon them, especially in the areas of plant conservation and environmental education. Many of these, have been enforced changes, due

to their need to find new financial and other resources. Funds have been increasingly difficult to attract for the more traditional activities of botanic gardens, especially taxonomic research and other work associated with their herbaria.

Many of Europe's botanic gardens have had to reassess their individual circumstances to help them adapt to changing situations. But many more institutions have yet to recognize that new involvement in plant conservation and environmental education may well be the only future they have, if they are not to become irrelevant to present day needs. The preparation of new strategic development plans is an exercise that many more botanic gardens should undertake. It may well be the key to a successful future and an effective way of ensuring that they are well placed to attract the financial and other resources they need.

The publication of "The Botanic Gardens Conservation Strategy" (IUCN-BGCS, 1989) has been important to help botanic gardens plan their plant conservation activities and update their individual missions.

As recommended by the Strategy, a key element of botanic garden development will be the preparation of individual mission statements. Hand-in-hand with this must go a re-assessment of their living collections and future accessions policies. Perhaps harder than reviewing the accessions policy will be creating a de-accessioning policy. Many plants in most botanic gardens are grown for no easily apparent reason. Obviously it may be going too far to suggest that every plant in a collection must have a clearly recognized immediate purpose. But if the presence of too many historic, low priority, often undocumented accessions is preventing the addition of new plants then a de-accessioning policy is required.

"The Botanic Gardens Conservation Strategy" has been published in Chinese, English and Portuguese and editions in French and Spanish are being planned. Copies of each are available from Botanic Gardens Conservation International.

Botanic gardens playing a part in integrated plant conservation

The successful conservation of many plant communities and plant species and populations will, in future, require increasingly active management. The days are gone where it was believed that an area or vegetation could be conserved simply by putting a fence around it. Few natural areas are not subject to increasing pressures, usually human caused, and most sites that are not actively managed and monitored are subject to increasing genetic erosion of the biodiversity they contain. Nowadays, few protected natural areas are sufficiently large to be able to function completely without human intervention or to be free of human interference.

Today a whole range of conservation techniques have been developed to conserve wild plant diversity, such as:

- land acquisition and management
- ex situ rescue and maintenance
- habitat reconstruction or restoration
- plant reintroductions
- preparation of biodiversity inventories
- legal and statutory instruments, and so on.

This wide range of diverse techniques is being undertaken by an equally wide range of organizations and institutions, most of which specialized in one or a few related activities or disciplines. In recent years in many countries there has been an increasing trend to bring together the often parallel approaches employed as integrated conservation action (FALK, 1990). It is extremely important that botanic gardens play their part in such programmes and strengthen their links with other non-garden institutions and agencies involved in biodiversity conservation. In Europe, some of the best models of integrated conservation in action have already been demonstrated by the work of such gardens as the Jardín Botánico Canario in Las Palmas de Gran Canaria, Spain in:

- documenting and recording the surviving natural vegetation of Gran Canaria and its endangered flora
- restoration of important natural habitats such as laurel forest,
- reintroduction of such species as *Dracaena draco* (SYNGE, 1991) and *Senecio hadrosomus* (GONZÁLEZ & al., 1990)
- extensive programmes in environmental education with local schools
- and working with the island's government to plan future plant and habitat conservation priorities and measures (BRAMWELL, 1987 and SYNGE, 1991).

Other notable examples are the programmes of the Jardín Botánico de Córdoba for the conservation of the endangered flora of its region of Spain (eg. SAINZ-OLLERO & HERNÁNDEZ BERMEJO, 1979) and the Conservatoire Botanique National de Porquerolles, France and its involvement in a Corsican plant conservation programme.

Elsewhere in the world, outside Europe, a range of new organizations or liaison groups are being established with integrated conservation as a primary objective. A notable example is the Australian Network for Plant Conservation, established in 1991, whose membership includes botanic gardens, the commercial horticultural industry, universities, government agencies and national parks management, local councils, non-governmental organizations and individuals (RICHARDSON & al., 1991). Another example is a proposed Indonesian Plant Conservation Network (WYSE JACKSON, 1991). These network organizations have recognized that if botanic gardens form themselves into exclusive inward-looking clubs they will be increasingly marginalized and ignored by the world's conservation community.

The need for plant conservation in Europe

The growing needs for the conservation of wild plant diversity in Europe, as highlighted by Akeroyd elsewhere in this volume has clearly pointed out new priorities for botanic gardens. Their traditional role in ex situ plant conservation remains as valid as it ever was. Increasingly sophisticated methodologies for storing and monitoring germplasm ex situ have been devised. New techniques for the re-establishment of plants in the wild are also being developed. Such changes have added to both the potential value and the quality of ex situ plant holdings.

In the 1970s, the predecessor to BGCI, the Botanic Gardens Conservation Co-ordinating Body, began to monitor the occurrence of rare and endangered plants in botanic garden collections. This work has continued ever since then. A recent count (based on figures from the World Conservation Monitoring Centre threatened plants database and WCMC 1992) gave a total of 2,716 rare or endangered plant species in Europe. So far BGCI has been able to locate only 846 of those species in cultivation — 31%. That is, almost 70% of the rare and endangered European plant species are

probably not being conserved at all by botanic gardens. And of the 31% that are grown, most are probably represented by totally inadequate genetic samples of the surviving wild diversity of each species.

If every botanic garden in Europe agreed to assume responsibility for only five species, perhaps from their local area, the conservation of the European flora could be assured. Obviously the task is not as easy or straightforward as that, but nevertheless, a recent BGCI survey indicated that there are, in total, more than 1.6 million living plant accessions in European botanic gardens. No one can argue that botanic gardens lack the capacity for their tasks in conservation. Some only lack the expertise, the resources and others, the will.

Botanic gardens of course can and do also play extremely important parts in conservation other than in maintaining *ex situ* collections, including the following:

- They manage nature reserves or work with other protected area managers or agencies
- They undertake survey and inventory work and plant exploration
- They prepare Floras and conduct taxonomic work — good taxonomy is fundamental to plant conservation.
- They carry out research in ecology, horticulture, land management etc.
- They help monitor and control damaging trade in endangered species
- They organize public education programmes to help increase environmental awareness
- They support sister organizations and institutions nationally and internationally.

Far from being institutions simply concerned with maintaining living collections, most botanic gardens are broadly-based botanical resources centres.

Documentation and records

The improvement of data management and maintenance standards for living collections in many botanic gardens is overdue. Suitable database management software is now widely available. Indeed, BGCI hopes to complete and distribute a simple database package for botanic gardens in 1993. We hope to be able to provide this at little or no cost to any botanic gardens that wishes to us it. This programme will be fully compatible with the "International Transfer Format for Botanic Garden Plant Records" (ITF) (BGCS, 1987).

The ITF is an agreed standard to assist the electronic transfer of data on living plant collections between institutions. It consists of 33 agreed data fields on the name, origin, form and status of individual living plant accessions in botanic garden collections. Each field is of fixed length and a set of definitions governing the use of each field is outlined in the published manual. Compatibility with the ITF has now been included in the major botanic garden living collection data management systems worldwide.

Although the ITF was published six years ago, very few botanic gardens are yet actually using it to exchange data with each other or with co-ordinating and monitoring databases such as that maintained by BGCI. In 1992, BGCI developed the capacity to electronically screen the holdings of individual botanic gardens. When BGCI receives ITF data from a botanic garden we compare each accession record with the complete world threatened plants file, as maintained by WCMC, and extract any matches. This allows the extraction of the plants of high conservation priority in

these botanic gardens, without having to undertake the laborious manual questionnaires on which data collection has relied in the past. BGCI then gives each institution contributing data, in return, a detailed analysis of the Garden's holdings, listing the IUCN Red Data Book Categories (l.c.) for each accession and information on what holdings are maintained in other botanic gardens.

Several botanic garden networks have created similar databases, bringing together the living collections in their member gardens as multi-site national or regional collections. For example, the U.S. Center for Plant Conservation in St Louis (FALK, 1992) and the Australian Network for Plant Conservation have created computer databases to allow them to monitor and manage the rare and endangered plants in affiliated gardens. More botanic garden networks in European countries should consider the establishment of monitoring databases on computer as a permanent part of their programmes. The ITF provides a simple and effective means for their operation. It is only through such co-ordination that individual botanic gardens will be able to ensure that they can contribute to wider plant conservation plans and be aware of what are the most urgent tasks and avoid duplication of effort.

Documenting genetic diversity

Greater attention must be given to preserving and tracking the genetic variation of individual plants maintained in cultivation. We now recognize that growing a few miscellaneous and poorly documented individuals of an endangered species often contributes little to the conservation of a species. Even still, very few botanic gardens have yet devised or implemented rigid procedures for managing individual clones in their collections. Guidelines for such procedures are given by BRAMWELL & HEYWOOD, *in press*). Such procedures are very important if we hope to conserve more than a small subset of the genetic variation of each species. Indeed, there have still been too few detailed research studies undertaken on variation patterns in populations of endangered species. Many European botanic gardens are ideally placed to undertake this research work, using laboratory studies to compliment their garden and field conservation programmes. The results of such studies will be essential in helping to plan guidelines for species recovery plans worldwide.

Species recovery programmes — the involvement of botanic gardens

Botanic gardens are uniquely placed to undertake species recovery programmes. Many of these programmes will in future involve plant reintroductions. Already many botanic gardens are becoming heavily involved in reintroduction experiments (AIELLO & al., 1992 and MAUNDER, 1992). Botanic gardens are often the only institutions holding adequate live plant material for reintroduction. They have the necessary research and propagation facilities and the horticultural and applied scientific skills to undertake the practical aspects of a species reintroduction programme. They can help to select species for reintroduction. They can propagate and raise appropriate plant material and help to establish it in the wild.

Clearly, the restocking and reintroduction of individual species into the wild and the reconstitution of whole communities will be an increasingly important means of conserving threatened plants in the future. But if it is to be considered as a valid conservation exercise, the reintroduction of species requires rigorous control, following strict guidelines. Ill-considered reintroduction experiments often fail, or cause damage to wild plant populations or habitats and contribute little to biodiversity conservation. Only as part of well-planned and carefully considered species recovery plans should reintroductions be attempted.

The basic guidelines needed for plant reintroductions have been developed by a number of organizations, most notable by the Reintroductions Specialist Group of the IUCN Species Survival Commission and by Botanic Gardens Conservation International. A BGCI document specifically focussing on botanic gardens is in the final stages of preparation and should be available in 1994.

Seed banks

Responses to a BGCI survey indicated that at least 200 botanic gardens in Europe report having a seed bank, although of these only 73 stated that they have facilities for the storage of seeds at low temperature. There is clearly a wonderful opportunity for many more botanic gardens in Europe to upgrade or develop new seed banks. Existing seed banks, such as those at the Jardín Botánico de Córdoba and Jardín Botánico Canario "Viera y Clavijo, Las Palmas de Gran Canaria, Spain and at the Royal Botanic Gardens, Kew, at Wakehurst Place, U.K., are ideally placed to be used as models for the creation of many more such facilities.

Furthermore, it is urgent and important that we devise a methodology for the exchange of data on holdings between these genebanks, as well as with the major crop genebanks. Many of the benefits of having germplasm conserved in this way will be wasted if few know what germplasm is conserved, where it comes from, in what form is it stored. Equally important will be knowing what germplasm has not yet been conserved in any long-term storage facility. Sharing information between these botanic garden seed banks on their holdings, research activities and methodologies is still, I suspect, very limited. The establishment of "Botanic Gardens Micropropagation News" has demonstrated that very effective and low-cost ways can be found to link people involved in similar disciplines in a wide variety of institutions. The BGCI network of educators in botanic gardens linked through the BGCI publication, "Roots — the botanic gardens education newsletter", has been similarly effective. BGCI has also developed plans to link people involved in plant records management and computers in botanic gardens as a co-operating network. Perhaps the formation of a similar network for those working in genebanks in botanic gardens should be considered?

Education

The developing role of botanic gardens in environmental education is particularly encouraging (eg. WILLISON & WYSE JACKSON, 1992). In many institutions new educational staff have been employed. The development of the new document, "The Strategy for Environmental Education in Botanic Gardens" (BGCI, in press), will be of great value in encouraging many more botanic gardens in Europe to develop education programmes and to help those gardens already active in education to refine and develop their activities in this regard. Education is moving from being a peripheral activity in many gardens to the centre of their concerns and activities and is being recognized as one of each garden's most important tasks.

There are many ideas, innovations and techniques to be learned from colleagues in environmental education which may also be of great value in helping the development and implementation of conservation programmes. Educators often have a talent for demonstrating how botany and botanic gardens can be good fun and places where a love of plants and enthusiasm for the environment can be fostered, especially for young people. Through their education work botanic gardens have excellent new opportunities to reach out into their local communities and to influence not only children but many important and influential target audiences.

Horticulture

Horticulture in botanic gardens has often been given low status, written off as merely a technique, rather than as a science itself. Yet good horticulture is the key to much successful plant conservation. It will be especially important in the implementation of many species recovery plans and habitat restorations. The low standing of horticulture has often been reflected in the humble status of horticulturists and curatorial staff in botanic gardens, who are often cut off from institutional decision making and project planning. Improving and integrating good horticultural planning and practices into botanic gardens procedures will be crucial in the management of individual plant populations in order to conserve and track the genetic variation of the individual plants within each population.

Innovative conservation and education projects, such as the Chicago Botanic Garden's prairie creation project, rely on very complex horticultural practices and extensive horticultural skills of the staff. A future priority for many more gardens must be to give new emphasis to research in horticultural techniques such as tissue culture, plant propagation, seed physiology and plant establishment. And too often the results of this work fails to reach the published literature. Above all, botanic gardens have a great ability to grow plants. If we cannot grow a plant, it is unlikely we will know how to conserve it. Involving horticulturists more in botanic garden networks will also yield very valuable benefits for improving plant conservation standards internationally.

Conclusion

The future is bright for botanic gardens in Europe if they can be innovative, imaginative and flexible. Many botanic gardens that are still quietly sleeping need to be awoken to join in the urgent plant conservation tasks we face. To be truly effective, the botanic garden community in Europe must become a closely co-operating partner with all those organizations and individuals involved in biodiversity preservation in Europe. If the European botanic garden programme is strong and well planned, we will also be better able to assist those in other regions where their conservation problems are much greater than ours and who urgently need our help.

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