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Practical aspects of plant conservation for a botanical garden: the relationship between botanical gardens and wild habitat

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ABSTRACT

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Plant conservation at all levels from gene to habitat is a much discussed item on the botanic garden agenda; it is forcing botanic gardens, such as the Royal Botanic Gardens, Kew, to assess their roles and priorities within the context of global change. It is increasingly evident that if botanic gardens fail to integrate themselves into this "big picture" they will subside into irrelevant historical legacies.

Botanic gardens need to consolidate links with the natural habitat, both to ensure that ex situ conservation programmes achieve their stated aims, and to link our important work to the broadest issues of conservation and development. In a world where population may grow by another 3.7 billion by 2030 and demand for food will double, can botanic gardens remain as dead ends for botanical novelties?

The work of the Living Collections Department (LCD) at Kew is aiming to support the conservation of all levels of biodiversity, from genes to ecosystems. This can only be attempted through collaboration.

The LCD in its institutional activities promotes habitat conservation in a number of ways:

— Participation in the English Nature Recovery Programmes for endangered native species.

— Collaborative projects on endangered species, particularly those from island ecosystems, linking closely with in-country programmes.

— Public education on the threatened habitats of England through educational displays.

— Management of nature reserve areas on the two estates (Kew and Wakehurst Place).

— Advice on protected area development and management in Venezuela, Cameroon and St Helena.

— Development of National Sustainable Development Strategies.

— Staff training programmes for field work and conservation techniques.

RÉSUMÉ

MAUNDER, M. (1993). Aspects pratiques pour le jardin botanique en matière de conservation de plantes: relation entre le jardin botanique et l'habitat sauvage.
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La conservation des plantes à tous les niveaux du gène à l'habitat est un point largement discuté dans l'agenda d'un jardin botanique. Cet aspect contraint les jardins botaniques, tels les "Royal Botanic Gardens" de Kew, à examiner leurs rôles et leurs priorités dans le contexte de changement global. Il devient de plus en plus évident que si les jardins botaniques ne s'insèrent pas dans cette "image globale", ils seront relégués au rang d'héritage historique hors de propos.

Les jardins botaniques doivent consolider les liens avec l'habitat naturel, de façon à ce que les programmes de conservation ex-situ puissent atteindre leurs objectifs et lier ainsi notre travail principal aux questions plus larges de conservation et de développement. Dans un monde, où la population atteindra probablement 3.7 milliards d'habitants d'ici 2030, et où la demande de nourriture va doubler, peut on imaginer que les jardins botaniques demeurent fermés aux nouveautés botaniques?

Le travail du Département des collections vivantes à Kew soutient la conservation à tous les niveaux de la biodiversité, des gènes aux écosystèmes. Cela ne peut se réaliser qu'au travers d'une collaboration.

Le Département des collections vivantes se veut être le promoteur de la conservation de l'habitat de plusieurs manières:

— Participation aux programmes anglais de rétablissement de la nature, pour les espèces locales en voie de disparition.

— Des projets de coopération pour les espèces en voie de disparition, notamment celles des écosystèmes des îles liés étroitement avec des programmes dans le pays.

— Sensibilisation du public au travers de programmes éducatifs sur les habitats menacés en Angleterre.

— Gestion des réserves naturelles en deux endroits (Kew et Wakehurst Place).

— Conseils sur le développement et la gestion de zones protégées au Vénézuela, Cameroun et Sainte-Hélène.

— Développement de stratégies nationales de développement durable.

— Formation de personnel pour le travail sur le terrain et les techniques de conservation.

Introduction

"The mission of the Royal Botanic Gardens, Kew, is to ensure better management of the Earth's environment by increasing knowledge and understanding of the plant kingdom — the basis of life on Earth. Our mission will be achieved through worldwide research into plants and the ecosystem, publication, access to all knowledge so gained for the world's scientific community, and through the display and interpretation to the public of the collections at Kew and Wakehurst Place. Whenever possible, the Royal Botanic Gardens will endeavour to reduce and reverse the rate of destruction of the world's plant species and their habitats."

The above mission statement clearly states that conservation and the rational management of plant resources cannot be tackled by examining single issues, a cross-sectoral approach is required.

One of the first botanic garden managers to recognise the relationship between a cultivated botanic garden accession and its natural habitat was Carl Linnaeus (Stearn, 1976). The early botanic collections were random extractions from the tropical biota carrying no associations with either habitat or ecology; they served as dramatic items of curiosity and taxonomic interest. In 1736 Linnaeus took charge of the botanical and zoological collection of an Anglo- Dutch banker, George Clifford. Linnaeus (1738, *Hortus Cliffortianus*) wrote: "The native place lays the entire foundation for the cultivation of plants. For if we have a considered record of the climate in each region according to the longitude and latitude of the place, if we have a record of the soil ... we know more data about cultivation that are true, unambiguous and reliable than if the gardeners left us laws of cultivation for each and every plant."

It was not until the 19th century that botanic garden display made any regular reference to natural habitat. The writings of Humboldt, Martius, Griffith, D'Orbigny, Wallace and others served to foster a fascination in the tropical world. The glasshouses of the Jardin des Plantes, Paris, the largest of their time in the 1830s, transported the citizens of Paris:

"The River Seine, seen from afar, is framed by these palms, these coconut trees, this banana plantation,..... and it is difficult not to start dreaming about the Nile or Ganges".

Public spectacle is still highly relevant to the botanic garden of today, however when the contemporary botanic garden curator or director starts "dreaming about the Nile or Ganges" romantic notions are clouded by a growing urgency to link botanic gardens' function to the real needs of a changing world.

Some of the work undertaken by the Living Collections Department of the Royal Botanic Gardens, Kew, illustrates the value of linking botanic gardens with the real world. The real world, the world of shrinking wild habitat and increasing human pressures, is changing quickly, accordingly botanic gardens are facing new challenges. This is not an historical precedent: botanic gardens' function has changed with history, from academic centres to colonial clearing-houses to centres for taxonomic research and public display.

Species recovery projects

The cultivation of a single clone of an endangered species may be a great asset for education and publicity; it is also practically irrelevant to securing the future of the species involved. The Royal Botanic Gardens, Kew, is encumbered with 1065 species with IUCN categories, 13 Extinct, 327 Endangered, 451 Vulnerable and 274 Indeterminate. This collection has developed at Kew as a historical legacy and the majority of the species are represented by single clones or original seed batches of limited size (MAUNDER, 1992b). The whole of the Living Collections was surveyed in collaboration with the Botanic Gardens Conservation International (BGCI) and the World Conservation Monitoring Centre (WCMC). As a result a number of species has been selected for priority action. The selection was aided by considering the following criteria:

— Status of the species in the wild.

— Opportunities for collaboration with other botanic gardens.

— Opportunities for collaboration with NGO groups and government groups in the country of origin.

— Links with existing projects within Kew.

— Chances of success.

Since this is a new venture the "confidence building" value of success in early ventures should not be under-estimated. The plants were selected from all areas of the collections, and in collaboration with horticultural staff managing the collections 3-year Action Plans have been developed. The priority species are as follows:

Sophora toromiro (Leguminosae)

Extinct in the wild on the Pacific Island of Rapa Nui. All stock in European collections originate from a single seed collection from the last surviving tree. A collaborative project between a number of European botanic gardens is being developed (LOBIN & BARTHLOTT, 1988, and ZIZKA, 1991).

Four Mascarene species have been selected:

Ramosmania heterophylla (Rubiaceae)

One plant survives on Rodrigues Island (STRAHM, 1989). Cuttings are being raised at Kew for future repatriation to Rodrigues and a multi-disciplinary project on its breeding biology initiated (OWENS & al., in press).

Zanthoxylum paniculatum (Rutaceae)

Only two surviving trees in wild (STRAHM, 1989), two seed-derived plants are in the Kew collection. Trials for conventional and in vitro propagation are underway with the aims of securing the species in cultivation and future repatriation to Rodrigues.

Scyphochlamys revoluta (Rubiaceae)

Probably less than 30 individuals of this monotypic genus survive on Rodrigues (STRAHM, 1989). Again cultivation trials are underway with the aim of securing the species in cultivation and repatriating the Kew stock.

Hibiscus liliiflorus (Malvaceae)

Endemic to Rodrigues and Reunion, probably extinct in Reunion and two surviving trees on Rodrigues (STRAHM, 1989). Material is being gathered from other collections in Europe and Hawaii to establish an experimental breeding group at Kew, with the aims of establishing a viable ex situ population and repatriating material to the Mascarenes.

Two species from the Atlantic island of St. Helena:

Trochetiopsis erythroxylon and *Trochetiopsis melanoxylon* (Sterculiaceae)

Both species of the endemic genus have gone through extreme genetic bottlenecks, both species have at one point in their recent history dropped to 1 or 2 wild specimens and are further threatened by demographic and environmental factors. The stock at Kew is part of a network to manage collaboratively the U.K. held material as a conservation biology research facility. A joint Kew-University of Reading project examining the genetics of U.K. cultivated stock (Rowe, unpubl.) has been developed into a full research programme at the University of Oxford under the direction of Dr. Quentin, the acknowledged authority on the Flora of St. Helena.

Impatiens gordonii (Balsaminaceae)

Endemic to the Seychelles and possibly extinct in the wild, its exact wild status is uncertain. Material has been gathered together from a variety of ex situ sources for cross-pollination. The resulting seed has been deposited at the Wakehurst Place Seed Bank and will be available for repatriation and cultivation when appropriate.

Gasteria baylissiana (Aloaceae)

This succulent is nearly extinct in the wild in South Africa (JAARSVELD, 1991). A collaborative propagation project is being run with Kirstenbosch National Botanic Garden, South Africa.

Abeliophyllum distichum (Oleaceae)

Down to possibly less than 20 in the wild in South Korea (Yong Shik Kim, pers. comm.). Material is being gathered from cultivated sources to set up a collection at Kew, with the long term aim of repatriating stock to South Korea. It is likely that the clones in European and North American gardens represent populations now extinct in the wild.

Calandrinia feltonii (Portulacaceae)

Appears to be extinct in the Falkland Islands, stock at Kew has been bulked up for storage at the Wakehurst Seed Bank, the status of the plant in the wild to be confirmed.

The above programmes are international and include an increasing number of formal agreements with other institutes and governments. The Mascarene projects were initiated by the urgency to consolidate our important holdings, notably *Zanthoxylum paniculatum* where by chance Kew holds half of the world population. It is necessary to develop fully a close working relation with the relevant land management agent. This is politically and logistically easier for U.K. based projects. RBG Kew's horticultural and seed-banking facilities have been built into English Nature's Recovery Programme for Protected Species (WHITTEN, 1990). This programme "suggests means by which each of the scheduled species would become a secure, self sustaining member of its ecosystem, and thus be considered for removal from the schedules" (WHITTEN, 1990). The actions in this plan include site management, research needs, enforcement needs, ex situ contingency requirements, translocation or re-introduction and monitoring. Using the facilities at Kew a number of species are being propagated for re-introduction, amongst them:

Cypripedium calceolus (Orchidaceae)

Many endangered terrestrial orchids are grown using symbiotic techniques. No suitable mycorrhizal fungus has been found in *C. calceolus,* and alternative methods are employed. Seedlings of native origin have been raised and planted out. Genetic finger printing is being carried out to assess the status of the last native wild plant and those held in cultivation.

Pyrus cordata (Rosaceae)

Conventional and in vitro techniques in process. A finger-printing programme with the University of Reading will allow identification of all unique genotypes to allow planning for breeding programme (JACKSON, 1992).

The RBG Kew Seed Bank at Wakehurst Place is undertaking a programme to collect and store genetically viable seed samples of all plant species protected in the U.K. by Schedule 8 of the Wildlife and Countryside Act.

Habitat management and education

These single-species operations are only part of Kew's response, a single-species focus can all too easily result in holding species within the dangerous evolutionary dead end of a botanic garden. In twenty years time the botanic garden community will be judged, not by our ever- increasing burden of the "living dead" sensu JANZEN (1986), but by the number of species surviving as viable populations as a result of botanic garden intervention. Like many botanic gardens RBG Kew has extensive reserves within its two estates. At Kew the Cottage Grounds are a valued urban haven for birds and possess a very rich hoverfly fauna. In conjunction with the NGO "Butterfly Conservation", Kew has developed a Butterfly Conservation Management plan for the Cottage Grounds and adjacent arboreta. This will entail restoring the original species rich grasslands and initiating more sympathetic sward management regimes (BELL, 1993). At Wakehurst Place the Loder Valley and adjoining S.S.S.I. are managed as areas of traditional Wealden landscape, this includes managing meadow and deciduous woodland. The area has a particularly rich bryophyte flora. The estate is used for public education, promoting the conservation of native species and vulnerable habitats such as wetlands; the supervised badger watching is proving very popular (Jackson, pers. comm.).

Protected areas and sustainable development

Recent publications such as the "Global Biodiversity Strategy" (WRI, IUCN, UNEP, 1992) and "Agenda 21" (UNEP, 1992) are fundamentally changing the philosophy and orientation of conservation. Our traditional perspective may still be too narrow when we focus on single species; our enthusiasms may appear both distorted and obscene to the millions whose perspective is dominated by insufficient food and water, inadequate shelter and fuelwood, no safe waste disposal, and a lack of health care, education and employment. Opportunities now exist to mesh botanic gardens as facilities promoting sustainable development. The retention of biodiversity is only one part of the sustainable development strategy. There are three main requirements basic to sustainable development: it needs to be ecologically sustainable, economically viable and socially desirable.

These ethics direct Kew's international projects, and in particular illustrate the need to balance conservation with the development ambitions of the country involved, and to develop incountry facilities and institutions. Agenda 21 states "Take action where necessary for the conservation of biodiversity through the in-situ conservation of ecosystems and natural habitats.... and the maintenance and recovery of viable populations of species in their natural surroundings, and implement ex situ measures, preferably in the source country". This and the Global Biodiversity Strategy place a great emphasis on capacity building. The temperate botanic gardens have a great responsibility to support, as equal partners in collaboration, colleagues in the high biodiversity regions.

Many tropical botanic gardens are awkward colonial legacies still searching for a function; of the approximately 67 botanic gardens in sub-Saharan Africa about 65% are colonial in origin. One such garden is the Limbe Botanic Garden, Cameroon, in West Africa. Established by the German colonial authorities in 1892, from the 1920s until independence it was part of the British colonial network with RBG Kew as the mother institute. Now in a combined project between the Cameroon government, British Overseas Development Agency (ODA) and RBG Kew the garden, herbarium and rainforest reserves are being developed as a facility for contemporary Africa. The gardens are being restored and an extensive staff training programme has been undertaken. This is based at Limbe and, for selected staff members, at Kew and elsewhere in Great Britain. The associated reserve areas include the internationally important Mount Cameroon. With time it is hoped that a facility serving local and national needs will develop. The single-species recovery bias will

have little relevance to a tropical botanic garden such as Limbe; instead it will become a centre supporting rainforest conservation and the sustainable utilisation of plant resources. In addition to work in Cameroon, LCD staff have advised on the management of an 80,000 hectare protected area and the establishment of a tropical field station in Venezuela (MAUNDER, 1992, 1993), and developing protocols for the selection of protected areas in South Korea (KIM & MAUNDER, 1992, 1993).

The isolated South Atlantic island of St. Helena is a famous example of island endemism, with 10 endemic genera and with circa 40 endemic species of flowering plants, 150 endemic insect species, 1 endemic land bird and 12 endemic species of marine fish (DRUCKER & al., 1992). In 1983 Simon Goodenough, then of Kew's LCD staff, with George Benjamin of the island's Agriculture and Forestry Department, prepared a conservation plan for the island endemics. Following this and the establishment of a nursery facility large scale re-introductions have taken place. For instance, the bastard gumwood *Commidendrum rotundifolium,* reduced to one plant in the wild, has been successfully propagated with over many 100's of plants raised. In total over 8,000 specimens of 14 species have been re-introduced.

This project has now advanced further, and through the efforts of the St. Helena Working Group the interests of various groups (such as Zoological Society of London, International Council for Bird Preservation, World Conservation Monitoring Centre, University of Oxford, and Royal Botanic Gardens, Kew and others) have been synthesised. In a new ODA funded initiative RBG Kew is managing a project to develop a national sustainable development strategy (NSDS) for the island (MAUNDER, 1993a). This will be a project run in collaboration with the International Institute for the Environment and Development (IIED). St. Helena offers a number of major challenges, the conventional paradigms of conservation have little relevance to an island whose original ecology has been virtually destroyed. The only natural vegetation surviving the nearly five hundred years of human pressure are tiny fragments of montane tree fern thicket and woodland. These relict areas are severely threatened by invasive introduced plants.

The large scale environmental degradation on the island began after the discovery of the island in 1502, this is reflected in the earliest known examples of plant species conservation. In 1718 Governor Poirier could locate no wild *Trochetiopsis erythroxylon,* in 1722 he located a couple of seedlings and brought them into cultivation. Previous to this action legislation had been enacted to protect the tree from over-harvesting.

In the eighteenth century various schemes were set in motion by the island council to protect timber supplies from destruction by domestic or feral stock. The "fencing" of Horse Point in 1725 promoted the massive regeneration of native species. This early impetus was sadly lost. The major phase of habitat destruction and clearance was complete by the mid-eighteenth century. These surviving relictual habitats continue to be subject to degradation from invasive exotics.

The result of this habitat destruction and modification has been 6 recorded extinctions of vascular plants. A number of surviving endemic species have been through dramatic and prolonged population bottlenecks:

Commidendrum spurium

Two wild plants survive, rediscovered in 1985.

Commidendrum rotundifolium

Rediscovered in 1982, as a single plant on a cliff.

Trochetiopsis melanoxylon

Rediscovered in 1980, two specimens on a cliff.

Trochetiopsis erythroxylon

All known plants through to be descended from one tree that died in the 1960s.

Nesiota elliptica

One surviving wild plant known, very difficult to propagate.

Lachanodes arborea

(e iscovered in 1977, total of 60 plants in the wild.

Phylica polifolia

Only 30 plants in wild, recorded population in 1870s of circa 100. All mature specimens dead.

Sium burchelli

Only 50 plants in wild, recorded in 1870s as very rare.

The island is now in a position where habitat restoration can expand upon relictual habitat fragments, and recovery programmes can expand populations of endemics. However, it would be foolish to think we can reproduce exactly the pre-colonisation ecology of St. Helena. The ecology has dramatically changed:

— Introduced species profoundly modifying ecological processes, these are now a permanent feature of St. Helena's ecology.

— Modified soil processes resulting from forest clearance and over-grazing, large areas of the island are now eroding semi-desert.

— Surviving populations of endemics subject to continued threats from inbreeding, stochastic events and invasives/pathogens.

— The needs of a human population. Food security for a remote island is of gre t social and political importance.

— Local microclimate has been adversely influenced through forest clearance.

Through reviewing the island's problems under the mechanism of a ational Sustainable Development Strategy a multi-sectoral approach is being developed:

— To maintain and restore populations of critically endangered endemics to viable levels.

— A network of core areas of strict invasive exclusion and management to be developed.

— To develop a flexible in-situ habitat management approach. Recognising we will be managing a dynamic vegetation system dominated by invasives.

— To develop research programmes to fill critical gaps in knowledge, notably population genetics, lower plant and invertebrate ecology.

— To build capacity amongst island conservation managers.

— To develop an ethic of awareness of the value of biodiversity in island life.

— To develop an innovative philosophy to ecological restoration, one that expands upon core relictual habitats and importantly develops an arid land pastoral-forestry scheme, using both native and exotic species.

— To develop a monitoring scheme.

— To develop an integrated pest management programme looking at both agricultural pests and insects adversely affecting endemics, for example the exotic Jacaranda Bug *(Orthezia insignis)* currently decimating the endemic *Commidendrum robustum*.

The traditional paradigms have been abandoned, instead a pragmatic balance between conservation and resource development is being sought. A new ecology is developing on the island, we cannot turn back the clock to a pristine pre-colonisation island.

Using data collected during the first mission to St. Helena in April and May, 1993, a full Recovery Programme for the island's endemics (plants and invertebrates) has been drafted (SEAL & al., 1993). This was developed during a Population Viability Assessment Workshop held in collaboration with the Captive Breeding Specialist Group (CBSG) of the Species Survival Commission (IUCN). The Conservation Unit (LCD) is currently working with the CBSG to modify the VORTEX programme for modelling population dynamics in small populations and the CAMP (Conservation Assessment and Management Planning) protocols for botanic garden usage.

The final strategy will result from a participatory process allowing St. Helena to identify its own social, economic and ecological objectives. For an isolated island community such as St. Helena with a long history of environmental degradation, balancing the needs of the present without compromising the choices of future generations will be a difficult process. The aim is to safeguard the island's endemic biota by linking conservation with economic and social development.

Training and education

All these new developments, the recognition of responsibilities beyond the botanic garden wall, need to be consolidated through institutional commitment. One of the most important is staff training. This is particularly important when new scientific disciplines are introduced into horticultural operations. Since 1991 Kew horticultural staff have taken part in training field trips to introduce them to "real world" problems of plant conservation. This has been undertaken in collaboration with the University of Reading. The training is undertaken in Almeria Province, Andalucia, Spain, where staff can be introduced to the problems of conserving point endemic species and the broader issues of protected area management, tourism, soil erosion, salinisation etc. As a result of these activities, staff recognise the responsibilities of both ex situ and in situ conservation and accordingly place botanic gardens in a more accurate perspective.

Public education is also of critical importance; indeed it could be argued that public education and interpretation should be recognised as amongst the highest priorities for modern botanic gardens. There is an urgent need to move botanic garden design forward, to create a potent educational resource that supports an institute's work, both ex situ and habitat based. Botanic gardens can play an important role in promoting research and the conservation of protected areas and species to the public. Here lessons can be learnt from zoos anxious to improve a sagging public support (MAUNDER, 1990) to create potent education displays. JANZEN (1986) wrote "the world gets rapidly bored staring at crocodiles, eucalyptus trees and koala bears. But give watchers their ecological stories and you gain not only their attention but a feeling... of the value of the wildland". Our specimens of endangered species become vehicles for messages of profound importance; *Sophora*

toromiro is a testimony to the ecological and social collapse of Easter Island, *Pyrus cordata* can be used to illustrate the destruction of western England's hedgerows. Botanic gardens have the potential to become major supporting bodies for tropical protected areas. A possible model is provided by the Minnesota Zoo directly funding rhino conservation (Seal, pers. comm.). Another model is the Ecosystem Survival Plan (ESP) founded in the USA during 1988 (GERSHENZ & SAUL, 1993). This scheme encourages zoo visitors to directly support habitat conservation through two routes; the Conservation Parking Meter where each donation indicates the conservation of 90 square feet of forest; the other Adopt-an-Acre links schools into habitat purchase schemes. Botanic gardens as one of Europe's most tangible links with the tropics have a great potential to start directly contributing to tropical habitat conservation.

Discussion

The artificial schisms between ex situ and in situ conservation are finally eroding; botanic gardens as the main agent for the ex situ conservation of wild plant resources merely sit at one end of a management spectrum. The vast majority of the world's species will survive only in protected areas, but this coarse filter approach (sensu HUNTER & al., 1988) will continue to leak species. Over 130 nations have together established some 6,900 major legally protected areas, together covering nearly 5% of the planet's surface (MCNEELY, 1992). The world's estate of protected areas will be the main bastion for species conservation, yet it has its limitations. Protected areas are permeable to people, pollution, species movement and importantly climate change.

If climate change becomes a reality, we will face a massive and sudden spasm of extinction. Many biologically important geospheric processes will be altered as a result of the "greenhouse" effect. These include coastal upwellings, fire regimes, snowmelt timing, soil processes etc. If plant populations have to be translocated in reaction to climate change (DAVIS, 1989) botanic gardens could be the main agents for such operations. The techniques for translocation and long-term storage need to be rapidly developed (MAUNDER, 1992). This will require a continued collaboration between protected areas and botanic gardens.

If botanic gardens are to develop as agents of conservation, rather than as a last chance safety net for the "living dead" a constant review process must set into operation. Where do botanic gardens fit into a world where the world population will reach 3.7 billion by 2030? Demand for food will double, industrial output and energy use will increase sixfold in developing countries (World Bank-Commission — World Development Report, 1992). Habitats are being lost, and will continue to be lost — in Africa only 40% of the continent's moist forests survived by 1986, only 7% is within protected areas (World Resources Institute, 1990). Botanic gardens alone cannot salvage any more than a fraction of the tropical forest's floristic diversity. There are only 67 botanic gardens in sub-Saharan Africa. These are located in 28 countries. One country, Republic of South Africa, accounts for 25% of the continent's total. The Netherlands have 38 botanic gardens in a country of 40,844 km^2 , with a native flora of 1,170 flowering plant species. This equates to one botanic garden for every 1075 km^2 and for every 30.8 native flowering plant species. Nigeria, in stark contrast, has 4 botanic gardens in a country with 4,614 native flowering plant species and an area of 923,700 km^2 . Following the same simplistic ratio, this is one botanic garden for every 230,925 km^2 and for every 1,154 native species. Support is needed not to create botanic gardens on a European model, but to allow development of facilities to support local needs and local ambitions. Here the botanic garden can act as an educational and political support for protected areas; a link between a fragmented and vulnerable reserve system and a public hungry for education. Education at all levels is perhaps our most potent weapon in the long struggle to retain both species and habitats.

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