Fl. Medit. 25 (Special Issue): 103-114
doi: 10.7320/FlMedit25SI.103
Version of Record published online on 26 November 2015

Vernon H. Heywood

Mediterranean botanic gardens and the introduction and conservation of plant diversity

Abstract

Heywood, V. H.: Mediterranean botanic gardens and the introduction and conservation of plant diversity. — Fl. Medit. 25 (Special Issue): 103-114. 2015. — ISSN: 1120-4052 printed, 2240-4538 online.

The botanic gardens of the Mediterranean have played an important role in the study of the plant life of the region through exploration, taxonomic and ecological studies, introduction of new material and more recently in the conservation of germplasm in genebanks, living collections and conservation, recovery and reintroduction of threatened species. Many gardens still house important germplasm of early introductions such as citrus fruits. The region houses a large number of botanic gardens but their distribution and range of facilities is very uneven and proposals are made for actions to remedy these problems.

Key words: Mediterranean, botanic garden, conservation, germplasm.

Introduction

For 700 years Mediterranean botanic gardens have had a major influence on the architecture, culture, sociology, science and economy of the region and their buildings, museums, libraries herbaria and collections represent a rich and important heritage. Celebrated botanists such as A. J. Cavanilles, A. P. de Candolle and F. Parlatore have been directors of these gardens while many others spent part of their careers there. Many new genera and species were described and classic national and local Floras were written by the botanists at these Gardens. In addition, large numbers of plants of scientific, ornamental and economic importance were introduced into cultivation by them and disseminated to other parts of the Mediterranean and beyond. The Gardens have also played an innovative role in the history of plant science: for example, the celebrated naturalist Luca Ghini (1490-1566) who instituted the first botanic gardens in Pisa and Florence between 1543 and 1545 at the behest of Cosimo I de' Medici, also created the plant press, first herbarium and instituted the formal teaching of medicinal botany and laid the foundations for modern pharmacognosy (von Engelhardt 2012). In recent years many of these gardens have changed their emphasis away from taxonomy and systematics and have made important contributions to the conservation of the Mediterranean flora through living collections and seed banks and their participation in species recovery and reintroduction programmes.

It is difficult to state unequivocally when the first botanic gardens in the Mediterranean were established. The forerunners were medicinal, physic or herbal gardens and the transition between them and the first botanic gardens as we recognize them today was gradual. There are records of medicinal plant gardens such as the *pomarium* or *viridarium novum* in Rome, Italy, created in 1277/8 by Pope Nicholas III, part of which was devoted to the cultivation of medicinal plants. In the Muslim period of El Andalus in Spain, there are historical records of what was probably the first introduction and acclimatization garden attached to the Al-Rusafa Palace of the Emir Abd al-Rahman in the 8th century. The Al-Rusafa garden was used to grow plants that were brought from Syria and other regions at the instigation of Abd al-Rahman so that they could be acclimatized and then distributed them to other parts of the country. This garden had many of the characteristics of what we consider to be a botanic garden today and has claims to be the earliest botanic garden in the Mediterranean and Europe (García Sánchez 1992; Ruggles 2000; El Faïz 2007; Montero 2014).

The first botanic gardens in the western tradition were founded as medicinal plant gardens of universities in the Mediterranean, particularly in Italy (Raimondo & Garbari 1986). A public medicinal and pharmaceutical garden – the Giardino de la Minerva was created in 1317-20 in Salerno in the oldest university. This would appear to be the earliest European botanic garden and although it still exists today there is little if anything remaining of the original foundation. In Venice a medicinal plant garden was created in 1333 by Gualtiero and it is reported that in the Middle Ages, and until the 18th century, Venice was the city boasting most botanical gardens in the world. Allegedly there were more than 500 botanical gardens![i]

From the 16th century onwards in Italy and other countries the first academic university botanic gardens were founded such as those of Pisa (1544) , Padua[ii] (1545), Firenze (1545), Bologna (1547), Ferrara (?1577), Zurich (1560), Leiden (1577), Paris (1579), Leipzig (1597), Montpellier (1598) and Valencia (1567). Many further botanic gardens were created in the European Mediterranean zone in the following centuries.

Calculus of Botanic Gardens in the Mediterranean

Today, the Mediterranean region houses a large number of botanic gardens but their distribution across the region and their range of facilities are very uneven. The number of botanic gardens in each country of the Mediterranean region is given in Fig. 1 but only those gardens that occur in the Mediterranean climate zone[iii] of the countries concerned have been included. The total number is approximately 170. It is not possible at this stage to give fully accurate figures.

The numbers of Gardens given for each country are subject to several caveats: the lists of botanic gardens given in BGCI's GardenSearch[iv] for individual countries does not agree with various national lists (e.g. for France GardenSearch lists 96 botanic gardens, arboreta and other institutions (accessed 10 January 2015) while the Wikipedia's List 'of all significant botanical gardens and arboretums in France' has nearly 300, including a large number of arboreta, as at 16 December 2014 (accessed 10 January 2015); and the CBD list of botanic gardens in France lists 104 botanic gardens (accessed 10 January 2015 but the

list dates from 2001); many arboreta are listed and it is often not clear whether they should be included; and it is very difficult in some cases to ascertain if a listed botanic garden or arboretum is operational in any meaningful sense. The appellation 'botanic garden' has been applied to a wide range of institutions, reflecting the diversity of factors that are used to define them, and in a number of cases, it is difficult to decide if a garden is a private establishment or should be regarded as a botanic garden.

Of the 170 botanic gardens listed (Table 1), by far the largest number (57) are found in Italy where most of the country occurs in the Mediterranean climate zone. Although France as a whole has as many if not more botanic gardens than Italy, most of them are in the non-Mediterranean zones where only some 20 occur. In Spain most botanic gardens occur in the Mediterranean zone which covers much of the country: 21 out of a total number of 29.

In contrast, with few exceptions, botanic gardens have not played an important role in the countries of the southern and eastern Mediterranean. The number of botanic gardens in North Africa and the Levant is relatively small, and often with limited resources and facilities and with species- poor living collections; and in the countries of SW Asia, with few exceptions, botanic gardens have not been developed either as scientific or educational establishments. More than half of the countries have one or two botanic gardens or none at all. Most of those that do exist are small and report few activities.

The botanic garden estate in the Mediterranean is remarkably dynamic. Many botanic gardens that were founded in the past have ceased to function and often little trace if any) remains of them while many new ones have been founded. In some cases, some or all of the original structure and location remains although little if any scientific or academic activity continues. In Granada, Spain, for example, the university botanic garden (Jardín Botánico Histórico de la Universidad), dates from 1783 and has undergone many changes and closures during the course of its history but much of the later walls and layout remains together with several trees (Fernández-Carrión & al. 1993). It was restored and brought

Tab. 1. Number of botanical gardens in the Mediterranean climate zone.

Albania	1	Lebanon	0
Algeria	3	Libya	0
Bosnia & Herzegovina	2	Malta	1
Croatia	7	Montenegro	0
Cyprus	1	Morocco	4
Egypt	8	Palestine	1
France	20	Portugal	9
Gibraltar	1	Spain	21
Greece	10	Syria	0
Israel	12	Tunisia	3
Italy	57	Turkey	8
Jordan	1		
Total		**170**	

back into use in 1998 as a botanic garden but is largely of historical interest, retaining the layout of the botanical school (systematic beds), corresponding to the 14 classes of the old Jussieu taxonomy (as rectified by De Candolle)![v]

Today, many of the Mediterranean's botanic gardens are under great financial pressure and have suffered severely from the recent economic crisis with their staffing and operating budgets cut. Others have never managed to establish themselves fully as modern botanic gardens and their capacity and functions are severely restricted. If one also takes into to account the imbalance in the distribution of Gardens across the region, and the large numbers of threatened endemic species in the region, it is evident that there is a lack of capacity to undertake the necessary conservation actions to maintain this unique biodiversity.

The N-S, E-W imbalance in the distribution of gardens

Although the reasons for the current imbalance between the number of botanic gardens on the northern shores and the eastern and southern shores are largely historical and economic, the problem still needs to be addressed if the necessary capacity for conservation and other action in these areas is to be provided. To alleviate these problems, much more effective cooperation and networking is needed as was already pointed out decades ago (Heywood 1990; Walters 1979). Several botanic garden networks or associations exist for the countries in the region. Until the late 1980s, the European-Mediterranean Division of the International Association of Botanic Gardens (IABG) provided a forum for discussion between the botanic gardens of the Mediterranean region. It went into abeyance when the European Botanic Gardens Consortium[vi] was established in 1994 under the aegis of IABG and BGCI which took over many of its activities for European Gardens but not those of the whole Mediterranean region. Regional networks such as the Ibero-Macaronesian Association of Botanic Gardens (Asociación Ibero-Macaronésica de Jardines Botánicos – AIMJB) and national associations exist but there is no specifically pan-Mediterranean network. The organization Med-O-Med as taken some initial steps to starting a botanic gardens network for the region in recognition of the fact that the 'number of Botanic Gardens in the Mediterranean and the Middle East is currently insufficient to carry out, on site and off, the necessary tasks for the conservation of local flora and phytogenetic resources'[vii] but progress is very limited.

It has been suggested that the formal 'western' model is not appropriate for the Levant region and that a local community-centred approach would be better. Perhaps by deconstructing the various roles that botanic gardens occupy today we might find a solution. Various kinds of botanic garden have developed over the centuries in response to the different conditions and needs of the times and new models may need to be developed in response to the rapid changes we are currently experiencing and already there are several examples.

Specifically, as regards conservation activities, many of the botanic gardens in the Mediterranean are too small in extent to accommodate substantial conservation collections of growing plants but several have established or house seed banks, some of which are substantial such as that at the Jardín Botánico de Córdoba, Spain which is the Germplasm Bank of the Environmental Agency of Andalucía (Banco de Germoplasma Vegetal

Andaluz de la Consejería andaluza de Medio Ambiente) and stores more than 7,000 accessions or propagules, mainly seeds, of more than 1500 different species of Andalusian plants and about 500 other Iberian endemic species.

It is notable that about half of the members of the EU-funded European Native Seed Conservation Network (ENSCONET), which ran from 2004 to 2009, were from the Mediterranean region and they are also well represented in the ENSCONET Consortium developed from it[viii]. GENMEDOC[ix] was an interregional network of seedbanks of the Mediterranean regions aimed at facilitating the exchange of technical information and adoption of common protocols for the genetic conservation of the Mediterranean flora and more especially those that occur in habitats included in the EU Habitats Directive. It was co-financed by the EU through the programme INTERREG IIIB MEDOCC and 2004-2006 and of the eleven participating institutions (botanic gardens, institutes, seeds banks), all but one (Tunisia) were in the European part of the region. GENMEDOC was succeeded by the project SEMCLIMED (SEMences CLImat MEDiterranée) which ran from 2006 to 2008 whose aim was to study the impacts of climate change on Mediterranean plants habitats and propose methods for their effective conservation, especially species with recalcitrant seeds for which *ex situ* conservation is problematic. Later these initatives led to the creation of GENMEDA[x], a network of plant conservation centres. It publishes the magazine *Odissea Seminum*. It is unfortunate these initiatives are all ephemeral when what is needed is a stable long term organization.

An innovative approach to plant life conservation has been developed in France where the Fédération des Conservatoires botaniques nationaux (FCBN), a network of 11 botanical conservatories (three in the Mediterranean region) has been created aimed at the conservation of the wild plant species of France and its overseas territories (Fig. 1; Nardin & Buord 2015). The model of the Conservatoire botanique national is that under an agreement with the Ministry of the Environment each Conservatoire is responsible for the knowledge and conservation of the wild flora and natural and semi-natural habitats of a territory made up of a number of Departments with a biogeographical coherence. Their conservstion programmes include *ex situ* (seed banking, cultivation of threatened species) and *in situ* actions in collaboration with protected area managers.

Another novel conservation network is the Andalusian Network of Botanical and Mycological Gardens in Natural Spaces (Red Andaluza de Jardines Botánicos y Micológicos en Espacios Naturales – RAJBEN) initiated in 2001. It consists of 12 botanic gardens in located in natural vegetation communities in different biogeographic zones and their role is the study, cultivation, conservation and display of the flora and vegetation of the areas, especially of rare and endangered plant species. By growing in their natural wild habitats, the plants are able to develop with minimum of human intervention.

Mention should be made of the unique Nezahat Gökyiğit Botanic Garden of Istanbul, Turkey is now well established. The latter is a unique 50ha (125 acre) Botanic Garden is situated in a busy motorway intersection in a residential area of Istanbul. Originally started in 1995 by Mr A. Nihat Gökyigit as a Memorial Park in memory of his late wife, Nezahat Gökyigit, its aim was to restore the environment in an area which had been severely destroyed by major motorway construction. On April 30th 2003, the Park became the 'Nezahat Gökyigit Botanic Garden'. It occupies 32ha and grows some 2000 species. Over 50,000 trees and shrubs species have been plant-

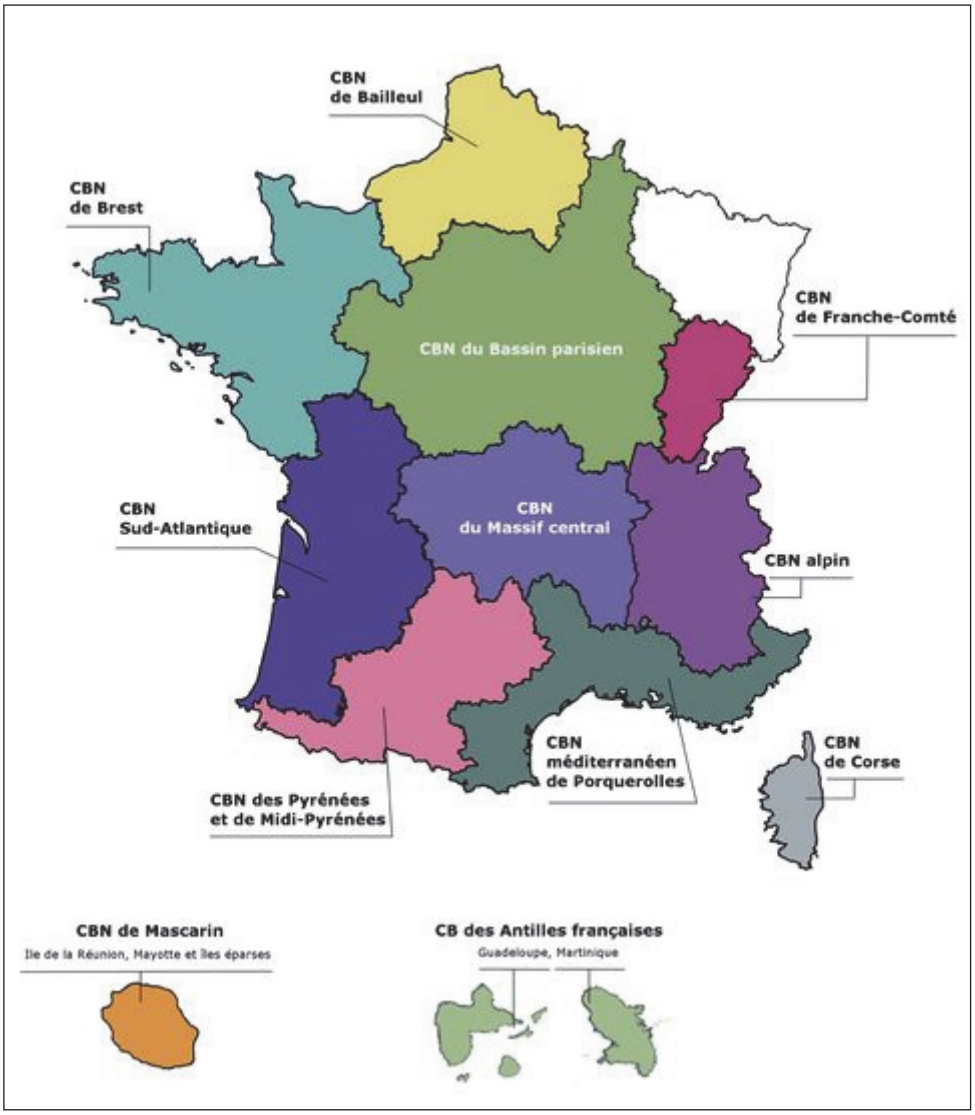

Fig. 1. The French Conservatoires botaniques nationaux (FCBN) network.

ed and it houses a seed bank, herbarium, library, a teaching and training centre, conservation collections of bulbous monocotyledons.

Also remarkable is the number of privately founded botanic gardens in the coastal areas of France, Italy and Spain, such as the Giardino botanico Hanbury (Muratorio & Kiernan 1992; Agostini 2007), the Jardín Botánico Marimurtra, the Jardin botanique privé Marnier-Lapostolle 'Les Cèdres' at Saint-Jean-Cap-Ferrat and the Val Rhameh botanical garden in Menton.

In addition, there are many important private gardens in the Mediterranean region, especially in Italy, France and Spain, some of which hold important collections of plants, a tradition that goes back at least to the days of Cosimo I de Medici. Although the early botanic gardens were responsible for many of the plant introductions, and were directed by academics, they were largely dependent on their patrons such as the Pope and the Medici family who also arranged for material to be collected for their own private gardens. As Attlee (2006) observes, in 16th century Italy, many of the most important plants collections were to be found in private gardens in Rome which became a leading centre of botanical study and research.

To shield some of the exotic introductions from the cold, especially citrus fruits, various forms of protection were introduced including cold frames, *stanzone per I cidri*, initially using windows or walls of thin sheets of mica, a tradition going back to Roman times, and later panes of glass, limonaie and orangeries (Saudan & Saudan-Skira 1998). Some of these lemon and orange houses developed as major architectural structures both in private and botanic gardens across Europe such as the limonaia of the Boboli gardens in Florence, Italy, La Gardette Orangerie, Jardin des Plantes, Montpellier and the Pabellón de Villanueva in the Real Jardín Botánico of Madrid.

Although limonaie and orangeries were the precursors of the spectacular development of greenhouses and conservatories in more northern countries with cooler climates and later across much of the temperate world, Mediterranean botanic gardens are not celebrated for their greenhouses. On the other hand some of the shade houses that were built are of considerable architectural merit such as the spectacular umbraculum of the Jardín Botánico, Valencia, Spain, dating from 1900.

Many original introductions of citrus species and cultivars are still found in both private and botanic gardens of the Mediterranean, especially in Italy (Attlee 2014) and although detailed records of their provenance are not always available, they represent an important germplasm collection and a proper survey and catalogue should be undertaken as a matter of urgency while the plants are still extant.

The dilemma of the old historic botanic gardens

Many of the Mediterranean botanic gardens, especially the historic ones such as Florence, Madrid, Paris, Pisa, Padua, Valencia, are small and exist like islands in large conurbations. These urban botanic gardens often face severe restrictions in their activities because of the lack of space: they are unable to set aside large enough areas for conservation collections and other activities of a modern botanic garden and since they cannot grow physically they have to grow qualitatively. They can, however, grow by proxy by establishing satellite gardens at some distance from the urban centre. Urban botanic gardens are often threatened with encroachment, peripheral tall buildings, water supply problems, expropriation for development, pollution, access and car parking problems, visitor pressure. Some may be forced to move because of pressure of development or for climatic reasons. Yet some manage to acquire additional land even within the city limits. The best form of defence by urban botanic gardens against encroachment or closure is to develop a major role in the local community – as a public educational centre, advice centre, training centre, scenario for cultural and social activities and as a tourist attraction.

At the same time, cities and other levels of government are increasingly, turning attention to naturalization of urban green space and returning ecological function to parks, greenbelts, and other open areas. Botanic gardens have been involved in this process as active partners, providing expertise, plant material, and even interpretive signage and educational programming. In addition, botanic gardens have a very special part to play in the urban context: they house a wide array of plant (and often also animal) diversity and afford the only opportunity many people will ever get of appreciating something of the variety of plant life.

Botanic gardens as centres of plant introduction and acclimatation

The introduction of new plants of agricultural, horticultural or economic importance has been an important activity of Mediterranean botanic gardens over the centuries (Heywood 2011). Large number of species were introduced into cultivation by Mediterranean botanic gardens over the past 700 years including many tropical and subtropical ornamental trees and shrubs that have become characteristic features of Mediterranean landscapes and townscapes.

Curiously, botanic gardens played a negligible role in the first introductions of plants from the New World after 1492 during the so-called Columbian Exchange (Crosby 2003), for the simple reason that hardly any of them had been established by that time (Heywood 2012). It was only in the following centuries that acclimatization gardens were established in the Mediterranean, mainly in Spain, France, Portugal and Italy. Acclimatization gardens created in Spain for the plants brought from overseas – in Cartagena, Cordoba (although short-lived), Barcelona, Aranjuez, Madrid, Burgos, Sevilla, Carmona, Cádiz, La Orotava (Tenerife), Valencia (see detailed discussion by Puerto Sarmiento 2002).

The term and indeed the concept of acclimatization is somewhat ambiguous and has been defined in markedly different ways. As I have noted elsewhere (Heywood 2102) 'the concept of acclimatization in the sense of gradual adjustment of plants or animals to new climatic or other ecological conditions other than those to which they are accustomed is highly debatable. It is in effect essentially a selection process (albeit often very idiosyncratic[xi]) rather than any physiological adaptation of individual plants or animals although some plants can be hardened off through gradual exposure to colder temperatures (this is sometimes distinguished as 'acclimatation' as opposed to acclimatization) while others succumbed to the cold…'

Many of the botanic gardens and private gardens of the Mediterranean acted *de facto* as acclimatation centres and plants that could not be maintained in the open were grown in cold frames, limonaie, orangeries or greenhouses. The Giardino botanico Hanbury was largely conceived of as a garden for the acclimatation of exotic species (Agostini 2007) and many of the 3500 species listed in its first catalogue of plants cultivated in the garden in 1889 were novel introductions.

Other gardens were specifically aimed at the acclimatation of alien introductions and one of the most celebrated is the Jardin botanique de la villa Thuret which has been engaged in the introduction and acclimatation of plants for over 150 years (Ducatillion & Blanc-Chabaud 2010).

Colonial and trial gardens

In addition, a number of so-called colonial gardens were established in some parts of the Mediterranean. In Italy, a number of gardens were opened in the 20th for the introduction of plants from their colonies. The Giardino Botanico Tropicale, Florence, managed by the Istituto Agronomico per l'Oltremare, is a garden primarily devoted to the cultivation of tropical plants. Opened in 1904, the garden has around 300 species of tropical plants primarily from Africa and America. Also in Florence, the Boboli Gardens included a botanic garden, Giardino Botanico Superiore, later transformed by the Italian botanist Filippo Parlatore into the Giardino degli Ananassi (Pineapple Garden) (Volpi 2003).

In Palermo, the Giardino Coloniale (founded 1903) which was developed alongside the Orto Botanico introduced and undertook experiments on many plants of economic importance. It was responsible for the introduction to and spread through the Mediterranean of species such as the Mediterranean mandarin (*Citrus deliciosa*) and Loquat (*Eriobotrya japonica*) as well as the reintroduction of cotton (*Gossypium* spp.), and the first European trials of ramie (*Boehmeria nivea*), candlenut (*Aleurites moluccana*), soya (*Soja hispida*) and more recently, sweet sorghum (*Sorghum bicolor*. Information on the introductions were published in the *Bollettino del R. Orto botanico e Giardino Coloniale di Palermo* (e.g. Borzi (1911).

In North Africa, the 16 ha Jardin d'Essais Botaniques (JEB), Rabat (Morocco) which opened officially in 1928 was an experimental garden that undertook trials on fruit trees and ornamental species. It fell into disrepair and has recently been restored and with a broader remit, including the conservation of Moroccan endemic species. In 2012, the garden was recognized by UNESCO as a World Heritage Site. An earlier foundation is the Jardin d'Essai du Hamma of Algiers, established under French rule in 1832, which today covers 38 ha of gardens and 20 ha of arboretum. It started life as a model farm and a trial garden, then became the government central nursery and later the Jardin d'acclimatation. In its day it was one of the most important acclimatization and trial gardens in the Mediterranean but later fell into disrepair and was eventually closed for some years. It re-opened in May 2009 after a major five year restoration in cooperation with the Ville de Paris.

Another North African garden that was of major importance for plant introductions is the experimental garden of El Saff about 50 km south of Cairo. Also in Egypt were the experimental gardens of Zohriya (today the Zohira Trial Gardens) Gezireh west of Cairo, in which Delchevalerie in 1870 established the first station for acclimatization of plants. Particular attention was paid to the propagation of tropical fruits such as the breadfruit tree (*Artocarpus altilis*), the sapodilla plum (*Manilkara achras*) and the mango (*Mangifera indica*) (Hamdy & al. 2007)

A trial Garden (Jardin d'essai) was opened in Paris in 1899 to undertake trails of potentially useful agronomic plants from the French colonies. After a varied history the site was acquired by the City of Paris which undertook a programme of restauration and the garden is now the Jardin tropical du Bois de Vincennes, Paris.

In Portugal, the Jardim Botânico Tropical (JBT) in Lisbon, was founded in 1906 as the Jardim Colonial with the aim was of bring into cultivation a diverse collection of plants from tropical and subtropical regions and to support the teaching of agronomy.

In the post-war years in the latter half of the 20th century, the role of botanic gardens as introduction centres in the Mediterranean (as elsewhere) was greatly diminished, partly due to a shift in priorities and partly due to a saturation effect: so many species of trees, palms, succulents and other ornamentals had been introduced in the previous centuries that there was little demand for additional species and as regards agricultural and forestry species, specialized agencies or institutes had taken over this role. The recent growth in the development of garden centres and nurseries (already common in more northern countries in Europe and in the USA) led to a demand by the public for novelties but botanic gardens have been slow to capitalize on this opportunity. Another recent demand for new plant introductions comes from the greening of cities movement and the growing use of green roofs, living walls and xeriscaping and the need for plants that are adapted to a warming and drier climate in parts of the region.

Conclusions

– Mediterranean botanic gardens have had a glorious past. Many gardens today are poorly financed and resourced and unable meet public expectations.
– Today many gardens have changed their focus are now engaged in active conservation and education programmes.
– Many gardens contain important germplasm of introduced cultivars such as *Citrus* and these need to be catalogued.
– Gardens need to renew themselves to meet the economic and societal challenges of the modern world and seek to establish a new compact with society. This may involve considering new models or structures.
– The imbalance in the present day distribution of Mediterranean botanic gardens needs to be tackled and much more effective north-south networking is is required.
– The possibility of developing a network of Mediterranean botanic gardens should be explored.

References

Agostini, D. 2007: I Giardini botanici Hanbury: luogo di sperimentazioni. – Quad. Ri-Vista, Ric. Prog. Paesaggio **4:** 22-25.

Attlee, H. 2006: Italian Gardens: a Cultural history. – London.

— 2014: The Land where the Lemon Trees Grow: A story of Italy and its Citrus fruit. – London.

Bardin, P. & Buord, S. 2015: Designing seed banks for *in situ* conservation purposes: more species or better quality? A key strategic issue for the reintroduction of rare species into the wild. – BGjournal **12(1):** 15-18.

Borzi, A. 1911: Il Giardino Coloniale di Palermo e la sua attività durante l'ultimo quadriennio 1907-1910. – Boll. R. Orto Bot. Giardino Colon. Palermo **10(1-3):** 3-13.

Crosby, A. W. 1972, 2003: The Columbian Exchange. Biological and cultural consequences of 1492. 30th anniversary edition. – Westport CT.

Ducatillion, C. & Blanc-Chabaud, L. 2010: L'Art d;acclimater les Plantes Exotiques. Le jardín de la villa Thuret. – Versailles.

El Faïz, M. 2007: Chapter in Michel Conan, M. and Kress, W. J. (Eds) Botanical Progress, Horticultural Innovation and Cultural Changes, **28.**

von Engelhardt, D. 2012: Luca Ghini (1490-1556) Il Padre Fondatore della botanica moderna nel contesto dei rapporti scientifici Europei del sedicesimo secolo. – Ann. Mus. Civ. Rovereto Sez. Arch., St., Sc. nat. **27:** 227-246.

García Sánchez, E. 1992: Pp. 987-999 in: Salma Khadra Jayyusi (Ed.), The Legacy of Muslim Spain (Handbook of Oriental Studies: the Near and Middle East, Vol. 12) (Handbuch der Orientalistik. Erste Abteilung, der Nahe Und Mi)

Ferrrari, G.B. 1646: Hesperides, sive, de malorum aureorum cultura et usu. – Romae.

Fernández-Carrión, M., Molero-Mesa, J. & García Montes, J. M. 1993: El Jardín Botánico de la Universidad de Granada. – Granada.

Hamdy, R. S., Abd El-Ghani, M. M., Youssef, T. L. & El-Sayed, M. 2007: The floristic composition of some historical botanical gardens in the metropolitan of Cairo, Egypt. – Afr. J. Agric. Res. **2(11):** 610-648.

Heywood, V. H. 1990: Objectives and strategies for a network of Mediterranean botanic gardens. – Pp. 57-61 in: Hernandez Bermejo, E. & al. (eds.), Conservation Techniques in Botanic Gardens. – Koenigstein.

— 2010: The role of botanic gardens as resource and introduction centres in the face of global change. – Biodiv. Conserv. **20:** 221-239. doi: 10.1007/s10531-010-9781-5

— 2012: The role of New World biodiversity in the transformation of Mediterranean landscapes and culture. – Bocconea **24:** 69-93.

Médail, F. & Quézel, P. 1997: Hot-spots analysis for conservation of plant biodiversity in the Mediterranean Basin. – Ann. Missouri Bot. Gard. **84:** 112-127.

Montero, A. 2014: Antecedentes históricos de jardines botánicos en Córdoba y origen del Real Jardín Botánico de Córdoba. Historical precedents of botanical gardens and origin of the Real Botanical Garden of Córdoba. – Bol. R. Soc. Esp. Hist. Nat. Sec. Biol. **108:** 53-64.

Muratorio, M.& Kiernan, G. 1992: Thomas Hanbury e il suo giardino/and his garden. – Genova.

Naudin, C. & von Muller, F. 1887: Msnuel de l'acclimateur ou choix de plantes recommandées pour l'agriculture, l'industrie et la médecine et adaptées aux divers cliamts de l'Europe et des pays tropicaux. – Antibes.

Raimondo, F. M. 1990. Orti botanici, giardini alpini, arboreti. – Palermo.

— (ed.) 1995: L'Orto Botanico di Palermo. La flora dei tropici nel cuore del Mediterraneo. – Palermo.

— & Garbari, F. 1986: Gli Orti Botanici in Italia in Montacchini, F. (Ed.), Erbari ed iconografia botanica. Storia delle collezioni dell'Orto Botanico dell'Università di Torino. – Torino.

Ruggles, D. F. 2003: Gardens, Landscapes, & Vision in the Palaces of Islamic Spain. –Pennslvania.

Puerto Sarmiento, F. J. 2002: Jardines de aclimatación en la España de la Ilustración. – Ciencias **68.** www.ejournal.unam.mx/ciencias/no68/CNS06804.pdf

Saudan.M. & Saudan-Skira, S. 1998: Orangeries: A Metamorphosis in Glass (Evergreen Series). – Koln.

Volpi, F. 2003: Giardino Botanico Superiore o degli Ananassi, in Litta Medri (Ed.), Il Giardino di Boboli. – Milano.

Walters, S. M. 1979: The role of Mediterranean botanic gardens in plant conservation. Il ruolo dei giardini botanici mediterranei nella conservazione della flora. – Webbia **34:** 109-116. doi: 10.1080/00837792.1979.10670162

Address of the author:
Vernon H. Heywood,
School of Biological Sciences, University of Reading, Whiteknights, Reading RG6 6AS, UK. Email: v.h.heywood@reading.ac.uk

---

[i] A Garden in Venice, 2015http://www.gardeninvenice.com/2013/02/ow-exotic-plants-came-to-venice-our.html

[ii] UNESCO added Padua's Botanical Garden to its World Heritage List in 1997.

[iii] The delimitation of the Mediterranean climate zone adopted here is that of Médail & Quézel (1997).

[iv] http://www.bgci.org/garden_search.php

[v] The University of Granada's Botanic Gardens. www.coimbra-group.eu/uploads/2012/Granada-botanic%20gardens.pdf

[vi] http://www.botanicgardens.eu/

[vii] http://medomed.org/category/network-of-botanic-gardens/directory-of-botanic-gardens/

[viii] http://www.kew.org/science-conservation/research-data/science-directory/projects/european-native-seed-conservation-0

[ix] www.genmedoc.org

[x] http://www.genmeda.org/en/home.php

[xi] In their manual of acclimatising plants, Naudin & Müller (1887) note that the process often begins with a packet of seeds, which when sown produce a diversity of plants from which only the most vigorous or best adapted to their new environment, or the most attractive in the eyes of the collector, are selected and then propagated by seed or vegetatively.