Historic Gardens and Climate Change

Recommendations for Preservation

STIFTUNG
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Back Cover: Sanssouci Park, Neues Palais (New Palace), view of the garden front in winter

Frontispiece: Imaginary view from the river Havel to the Vineyard Terraces of Sanssouci Palace in an over door painted by Charles Sylva Dubois, Potsdam, Sanssouci Palace, Concert Chamber (SPSG, GK I 8241)

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International experience

The influencing factors: soil and water

Graziano Ghinassi, Tessa Matteini, Roberto Ferrise and Paolo Grossoni

The role of water and climate change in the conservation of the historic gardens of Central Italy

"A garden is not the hibernating ghost of itself; it is a metaphor, or rather a smaller version of those qualities of nature which the present generation of human beings at any time sees as being the most important, of the longings and depressions of Arcadia, the heightening of productive work in agriculture or forestry. These qualities include heat and cold, drought and moisture, the wind or the still air, the bench for old people to rest on, the lovers' corner, the play area for the children, the sand pit for the very young. The philologically most correct, at the same time most natural form of restoration would accordingly be a continuous renewal, with ongoing qualitative additions which are adapted to current personal and public requirements."[1]

The charter of ICOMOS-IFLA (International Council of Monuments and Sites-International Federation of Landscape Architects), drafted and approved in Florence and therefore known as the Florence Charter, defines the historic garden as "a work created using structural and botanical resources, in which there is a public interest for historical or artistic reasons", and furthermore as a "living monument".[2] The adoption by the Charter of various statements which had been hotly contested by the Italian participants – among them the reference to "restoration" and the "tendency to a reductive oversimplification of a complex phenomenology, along with the instrumentalisation of history through the eclectic approach to stylistic values"[3] – prompted the *Comitato Italiano* (the Italian delegation), to which Isa Belli Barsali, Marco Dezzi Bardeschi, Pier Fausto Bagatti Valsecchi, Lando Bartoli and Guido Moggi belonged, to draft a 'Counter-Charter'. This was elaborated at the Academia delle Arti del Disegno a Firenze (the Florentine Academy of the Arts), and was signed on 12th September 1981.[4]

Cultural references: the historic garden from 'monument' to 'resource'

According to this *Carta Italiana* (Italian Charter), a historic garden is "a totality planned by human beings, the essential parts of which have been realised through the use of living materials and which has been set up on a terrain or natural environment determined by human actions (which it consequently modifies). In its artificiality, it is a work of art and therefore a cultural asset and an architectural and environmental resource, belonging to the heritage of the entire community that makes use of it. The garden, like any other resource, is an enclosed, vulnerable and unrepeatable unity which is subject to its own developmental process and has its own history of birth, growth, change and decline, one that reflects the society and the culture which has conceived, constructed and used it and which manifests itself through it."[5]

The 'Italian Charter', which sees the present text – along with the *Convenzione Europea del Paesaggio* (European Landscape Convention), signed in Florence in the year 2000 and ratified by the Italian government in 2006 – as its central point of reference, thus underlines the importance of the historic garden as a common heritage, as a living and limited resource. It emphasises its relations with the surrounding landscape and environment, which are fundamental for the acknowledgement of its defining properties and the planning interventions that affect it.[6]

Definition of the subject area

This essay is concerned with the historic gardens of the climatic zone comprehending the hilly regions of Central Italy and their approaches, with a special focus on the Medici gardens,[7] which were made part of the UNESCO World Cultural Heritage in 2013.[8] The choice of a network of gardens forming a territorially delimited, organic, cultural, climatic and geographical unity seemed to us the necessary foundation for a target-oriented study which aims to serve the purposes of an "active and inventive form of conservation".[9]

The composition of plant structures in the gardens of the Medici villas

For the general assessment of the botanical structure of the Italian parks and gardens, comprising both trees and shrubs, we refer to the hitherto unpublished table, reproduced below, compiled by Professor Guido Moggi, Professor of Botany (now retired) at the University of Florence. In the Medici gardens we can state that the composition of plants may be broken down into a structure consisting of an area of trees and shrubs (as a rule lasting for many years), and another one that is changeable and is constantly being renewed, essentially defined by bulbs and grasses (annual, biennial or perennial). Frequently the garden system is supplemented by a *selvatico* or wild zone, an artificially constructed wooded area which is located to the north of the grounds and serves to shelter the garden from the northern winds (the *tramontana*). It was mostly used for the rearing of small animals for food production. In many gardens, like that of the Villa Castello, we also find collections of citrus plants, including some imported to Tuscania from Campania by way of Pisa from the 15th century on.

The arboricultural structure is frequently based on a planned botanical architecture having either aesthetic, functional or hunt-related values (in the *ragnaie* or *cerchiate*,[10] as these may be seen in contemporary pictures like the lunettes of Giusto Utens). It is made up for the most part of species that love dryness, heat and lime in the soil, and which are generally designated as Mediterranean.[11] These include

1 Battisti, 1989, p. 217–222.
2 Florence Charter, 1981, Articles 1 and 3.
3 Giusti, 2004, p. 175.
4 Matteini, 2010.
5 Pozzana, 1996, p. 236.
6 Matteini, 2011.
7 For more in-depth historical information: Galletti, 1998, pp. 51–68. – Giardini medicei (Medici gardens), 1996.
8 The 'Medici villas and gardens in Tuscany' were added to the heritage list at the 37th meeting of the UNESCO World Heritage Committee, 16.–27. 6. 2013, Phnom Penh.
9 On the term, see Donadieu, 2006.
10 A *ragnaia* is a feature of botanical architecture so called after the *ragne*, the nets suspended in parallel and designed to catch birds. The *cerchiata* is a formation in which *Quercus ilex* is grown in a curve forming a circle. Both are common in the Medici gardens of the 16th and 17th centuries.
11 Galletti, 2003.

Giusto Utens: The Pitti Palace and the Belvedere Fort, 1599, 143 × 285 cm, 1599, Florence, Museo di Firenze com'era (Museum of Florence As It Was)

the holm oak (*Quercus ilex*), laurel (*Laurus nobilis*), western strawberry tree (*Arbutus unedo*), the broad-leaved and narrow-leaved mock privet (*Phillyrea latifolia*, *Phillyrea angustifolia*), and the Italian buckthorn (*Rhamnus alaternus*). None of these as a rule need watering (except perhaps in the first two years after being planted). They are combined with compatible species like the evergreen snowball (*Viburnum tinus*), myrtle (*Myrtus communis*) and box (*Buxus sempervirens*). The difference in size between the various species forms the basis for an architectural structure consisting of plants with different specifications, which is not empty at the base but rather, in view of the diversified botanical configuration and composition, retains its shape – with each individual plant or plant species occupying a different level of height. Nonetheless, they only require a relatively small amount of maintenance.

Among the perennials common in the gardens of the 16th and 17th centuries, we furthermore find gymnosperms in shrub or tree form – like the cypress (*Cupressus sempervirens*), juniper (*Juniperus sp.*), yew (*Taxus baccata*), silver fir (*Abies alba*), Atlantic cedar (*Cedrus atlantica*) and cedar of Lebanon (*Cedrus libani*).

In the course of the 18th and 19th centuries – frequently in connection with the fashion for landscaping garden design, which became popular in Italy from the last quarter of the 18th century on – different species were introduced into many gardens, including deciduous species and exotic trees from Asia and America. The species most commonly featured are the London plane tree (*Platanus x acerifolia*), the horse chestnut (*Aesculus hippocastanum*), the linden (*Tilia sp.*), the tulip tree (*Liriodendron tulipifera*), the liquid amber (*Liquidambar styraciflua*), the camphor tree (*Cinnamomum camphora*) and the ginkgo (*Ginkgo biloba*). Among the conifers of exotic provenance, we frequently find the redwood or wellingtonia (*Sequoia sempervirens* and *Sequoiadendron giganteum*), the incense cedar (*Calocedrus decurrens*) and the Lawson cypress (*Chamaecyparis lawsoniana*).

Deciduous species are attested since the time of the Renaissance within the Boboli Gardens in Florence, we find a figurative matrix which is of fundamental importance for the garden design of the 16th and 17th centuries: *il Mezzo tondo di verzura* (the semicircle formed of vegetation), as it can clearly be seen in the view of the 'Belveder con Pitti' ('Belvedere with Pitti Palace') by Utens. It was designed by Niccolò Tribolo for Cosimo I dei Medici and Eleonora of Toledo. The semicircle is derived from the forms of gardens in antiquity, as these are known from the descriptions of Pliny the Younger. It was the hinge and crux of the garden composition developed by Tribolo, which he derived from the modification of a previously existing quarry. It was destroyed when the stone-walled amphitheatre existing today was erected between 1631 and 1637.

In its original design the space once occupied by the quarry was defined by a *cavea*[12] formed by plants, divided into regular modules or compartments and made up of tree plantations consisting of both evergreen and deciduous species. It thus formed a kind of *Theatrum Naturae* or natural theatre, with the idea of demonstrating, in the landscape designed by Tribolo, a repertory which would reflect both the order, and the specific and seasonal variability and diversity of the entire plant kingdom.

The design was executed in two phases. In 1550, the natural basin formed by earth excavation was systematised and divided up into compartments. The following year saw the instrumentalisation of this space, under the direction of Davide Fortini, with the different zones being consistently planted with a single tree species, as the *Quaderno delle Spese* (Record of Expenses) of Eleonora of Toledo confirms.[13] This notebook tells us that turkey oaks, beech trees, maples, lindens, planes, chestnuts, nut trees and cornel cherries were planted on 13th March 1551, twelve of each kind having an allotted place. On 4th April of the same year, these were followed by the *tamarigia, schotani e sechomori*,[14] in accordance with a structure characterised by variety and botanical diversity. This has disappeared today, having been replaced by a monospecific wood of holm oaks which are now in an exceedingly poor phytosanitary state of health.

This makes it evident that the climatic conditions and gardening culture of the mid-16th century made it possible for species to be planted which, like beech or chestnut, actually belong to more severe climatic zones. Today it would be unthinkable to introduce such species to the urban area of Florence.

12 The spectator area in antique theatres and amphitheatres, based on the natural inclination of the hill, or, in the case of Roman theatres, almost always rests on a substructure (based on http://www.treccani.it/enciclopedia/).
13 ASFi, Scrittoio delle Fortezze e Fabbriche, f. 68, 24, reproduced in Galletti, 1998, p. 58.
14 Identified by Galletti, 1998 as *Tamarix gallica, Cotynus sp.* and *Ficus sycomorus.* For this last one, Guido Moggi proposes the identification with *Acer pseudoplatanus*.

As for the bulbs and grasses, on the other hand, over the years the varieties originally used in the gardens of the 16th century were successively supplemented and varied on the basis of new botanic discoveries coming from Asia, America and Oceania. Along with blossoming herbaceous plants like rose and peony, the most frequently occurring varieties also include all kinds of bulbs like the tulip (*Tulipa*), lily (*Lilium*), daffodil (*Narcissus*), hyacinth (*Hyacinthus*), iris (*Iris*), lily of the valley (*Convallaria*), fritillary (*Fritillaria*), anemone (*Anemone*) and daylily (*Hemerocallis*). In the case of the herbaceous plants and grasses, the constant need for water (especially in early spring, which coincides with the flowering period of these ornamental varieties – the reason why they were cultivated in the first place) means that a review of the species used is called for.

In this connection – and with particular reference to the sustainable use of water as a resource – it could be interesting to fall back on flowering herbaceous plants of the Mediterranean cultural zone, the use of which has been historically documented. These may include the following: garden and meadow sage (*Salvia officinalis, Salvia pratensis*), thyme (*Thymus vulgaris*), the sage-leaved and Montpellier rockrose (*Cistus salviifolius*, *Cistus monspeliensis*), yarrow (*Achillea millefolium*), valerian (*Centranthus ruber*) and lavender cotton (*Santolina chamaecyparissus*).

The collections of citrus plants in terracotta pots, on the other hand, are currently – with the exception of the bitter orange (*Citrus x aurantium*), which is trained on espaliers – being transferred to orangeries during the winter. In Central Italy, by contrast with the countries of northern Europe, such orangeries are not heated. Global warming might make it possible for citrus to be planted in the ground, or at least to refrain from moving it to an orangery in the winter months.

Water and climate changes in the region of Florence

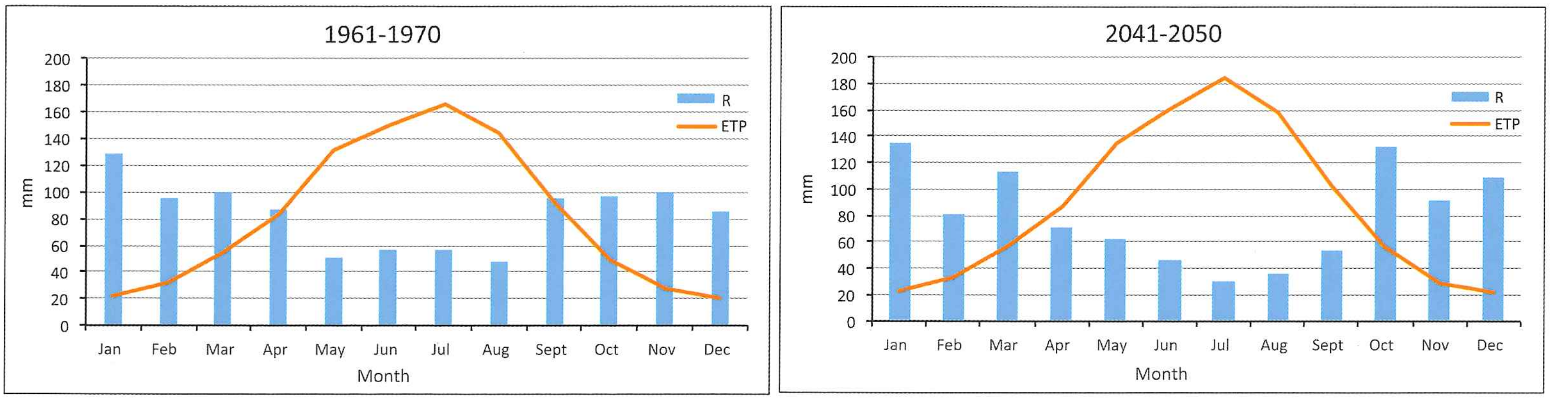
The meteorological data on which this study has been based are derived from the regional climatic model PROTHEUS, which was developed under the auspices of the European CIRCE project (Climate Change and Impact Research: The Mediterranean Environment).[15] Its goal is the development and use of models which permit an accurate representation of the Mediterranean and its influence on climate dynamics, as the basis for predictions of climatic change in the Mediterranean region.[16]

The data applied here relate to that part of PROTHEUS which is relevant to the area of Greater Florence. They are made up of temperature values for daily minima (T_{min}) and maxima (T_{max}), precipitation (R) and overall hours of sunshine. The daily values for evapotranspiration (ETP, evaporation and transpiration) have been calculated using the Hargreaves formula, as this has been described by Richard G. Allen and others.[17] For the production of ten-year climatic data, the daily values have first been transferred to a monthly scale, on the basis of which the ten-year mean was then extrapolated.

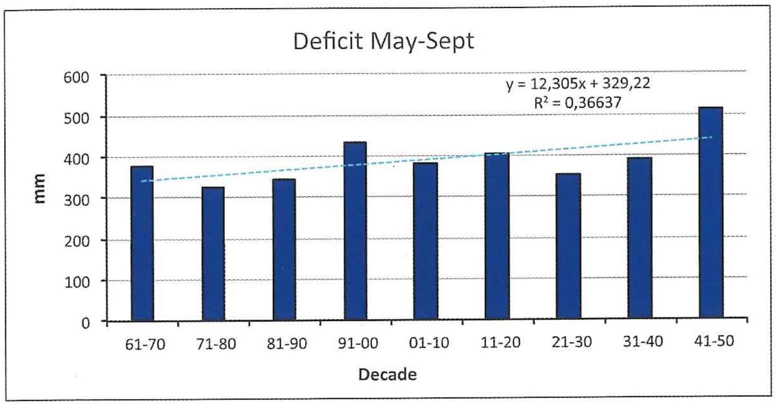
In agreement with forecasts for the entire Mediterranean basin, those relating to the region of Florence likewise envisage a seasonal distribution of precipitation which tends in the direction of being concentrated on the autumn and winter months. The lower rainfall in the spring and summer periods seems to correspond to an increase in the ETP. The illustrations below gives a representative illustration of the distribution of R and the patterns of the ETP for the earliest and latest of the decades investigated. Between the two periods we find a decline in mean annual precipitation rates of approximately 4 %, matched by a rise in the ETP of 7 %. But a particularly sharp differentiation between R and ETP can be expected in the months from May to September (those with the highest evapotranspiration demand).

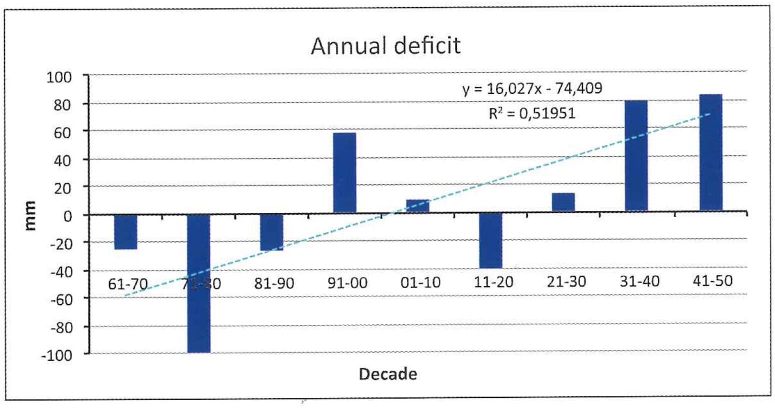
The data of the climate model mean that during this period the ETP is always greater than the precipitation depth, and that the difference increases by around 12 mm per decade (see illus. p. 105 up, left). In the other months, on the other hand, the precipitation values are higher,[18] so that they tend to balance out the losses of the spring and summer months. In order to highlight when and to what degree this will happen, for each decade of the entire period under investigation the difference between the water deficit from May to September and the rain excesses from October to April have been calculated (see illus. p. 105 up, right). The results boil down to the fact that the water deficit would be negative in the first 30 years, because the rainfall is capa-

15 See Artale/Calmanti et al., 2010. – See also: http://www.circeproject.eu/.
16 Gualdi/Somot et al., 2013.
17 Hargreaves/Hargreaves/Riley, 1985. – Allen/Pereira et al., 1998.
18 But even for April these forecasts predict a rain deficiency.



Potential evapotranspiration (ETP) and rain frequency (R) in the earliest and latest decades of the period investigated





Development of rain deficit levels in the period from May to September (left) and the balancing quantities of rainfall between October and April (right)

ble of balancing out the ETP. In the subsequent period, the deficit would be positive, with a tendency to increase by 16 mm per decade.

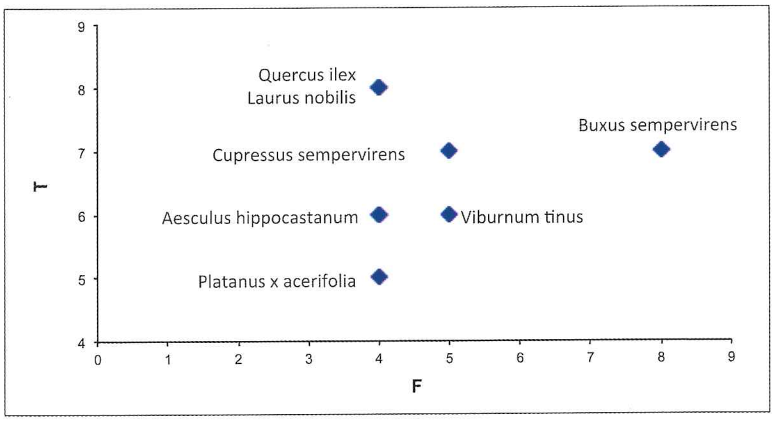
Water and climate change in the complex of the Medici villas

These numerical values make a meaningful statement in terms of climatic tendencies, but cannot give us any exact information on the different specific conditions by which plant species will be affected in the future. But if we resort to the eco-indicator values of the Ellenberg system as applied to the flora of Italy,[19] it becomes possible to arrive at conclusions about the habitat populated by the different species, without any need of direct chemical or physical measurements. But the information derived from these scenarios could be used for the purpose of evaluating any shifts in comparison with the conditions of today. For this purpose, some species have been selected which are to be found in the majority of the historic gardens of the Florence region: *Quercus ilex*, *Cupressus sempervirens*, *Laurus nobilis*, *Viburnum tinus*, *Buxus sempervirens*, *Platanus x acerifolia* and *Aesculus hippocastanum*. By using these trees an eco-diagram (illus. below, left) has been developed, which just shows the indicator values for soil humidity (F) and temperature (T).

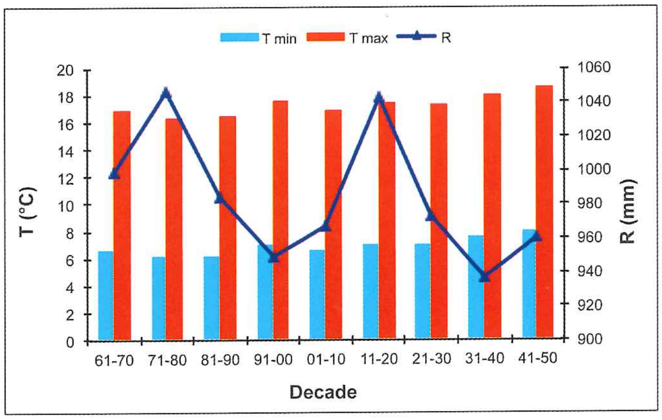
It may be observed that the values for F change little, which confirms that the garden soils in general are cool and well drained. The values of T indicator, on the other hand, show how the temperature varies within a short range, and so is compatible with the microclimatic differences to be observed within the gardens. The gardens of the Medici villas are all very similar in their position, morphology and exposure. They are generally positioned in slightly sloping locations at the foot of a hill, oriented to the south to southeast, and they mostly have clayey soil which is deep, well structured and well drained and contains an abundance of organic substances. The different microclimatic zones within a garden support the presence of species which have different requirements in relation to light, temperature and ground humidity.

The trend lines not shown in the graphic indicate, as a ten-year average, a reduction of precipitation by around 7 mm and a rise in temperature of around 0.2 °C. This situation could have negative effects on species with the lowest values for the indicator T. Of greater importance seems to be the increase in ETP in spring and summer, which is balanced out by precipitation to an ever lessening degree. This may result in changes to the soil humidity (F) to such a degree that mitigation strategies become necessary. As a basis for evaluating this possible necessity, table on top of the next page shows some supplementary information relating to the indicator F, the capacity for active root penetration (RD) and the intake of water from the soil (WA).

19 Ellenberg, 1979. – Pignatti/Menegoni/Pietrosanti, 2005.



Eco-diagram for some species occurring in the gardens of the Medici villas



Development of values for minimum temperature (T_{min}), maximum temperature (T_{max}) and rainfall (R) in the period from 1961 to 2050 on the basis of the PROTHEUS model

	F(1)			RD	WA
Quercus ilex	*xx*	*x*	*m*	high	high
Cupressus sempervirens	*xx*	*x*		low	medium
Laurus nobilis	*x*	*m*	*f*	low	medium
Viburnum tinus	*x*	*m*	*f*	low	medium
Buxus sempervirens	*m*	*f*		medium	low
Platanus × acerifolia	*f*	*h*	*hh*	medium	high
Aesculus hippocastanum	*m*	*f*		medium	medium high
Iris florentina	*x*	*m*		low	low

(1) ground humidity: *xx*: permanently very dry soil · *x*: soil dry in summer · *m*: well-drained soil · *f*: cool soil · *h*: very moist soil · *hh*: permanently wet soil

Properties of some representative species found in the Medici gardens with reference to ground humidity (F), active root depth (RD) and the capacity for absorbing water from the soil (WA)

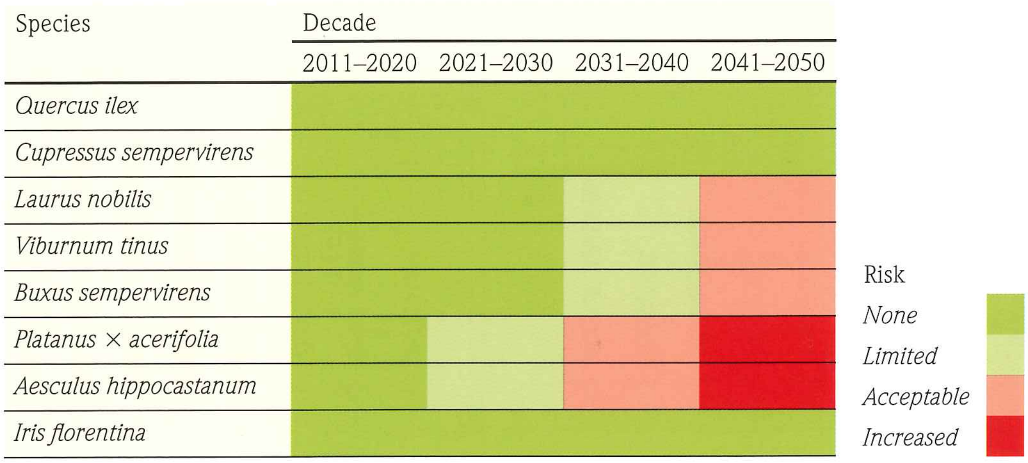
The information shown in the table permits the conclusion that both *Quercus ilex*[20] and *Cupressus sempervirens*[21] are capable of adapting to a scantier water supply than exists at present, similar to the *Iris florentina*, which stops growing in summer. *Laurus nobilis* and *Viburnum tinus* grow in zones with precipitation characterisitc similar to that of *Quercus ilex*, but their less effective capacity for controlling water loss could point to a risk of water deficiency. *Buxus sempervirens* thrives in regions with precipitation values ranging between 500 and 1200 mm, not a very wide range when we consider its limited capacity for absorbing water through the roots. *Platanus x acerifolia* needs permanently wet ground, whereas *Aesculus hippocastanum* is characterised by the tendency to maintain a high rate of transpiration even in summer.

The information reproduced here makes it possible for us to establish four levels of risk of water deficiency in case of climate change, for each of the species common in the hills and at the foot of hills of Central Italy, viewed from the present decade to the end of the period surveyed (see table below).

In the area under investigation, we find concerns beginning to emerge from the start of the decade from 2021 to 2030 for species with characteristics like those of *Platanus x acerifolia* and *Aesculus hippocastanum*. Even if in differing degrees, this risk could extend in the following decade (the 2030s) to include species which have not been affected previously, with 8 out of 13 (or 60 % of all species) now being affected. If the current trend is maintained, it is only consistent to assume that after the period under consideration, growing problems of water availability may be anticipated, that these would go on to affect further species and that the consequences of these problems would also become more serious for the affected species. The impact of climate change on the botanical species is, as a rule, countered by means of adaptation strategies which – as in the agricultural sector, for instance – envisage the use of watering systems or the choice of different species and varieties.[22]

The use of water-dispensing systems in the Medici villa gardens has been on the whole restricted in the past to the citrus plants. In some cases, as at the *Piano degli Agrumi* (the citrus quarter), this has been carried out with a technique

20 Thrives in zones with precipitation levels between 350 and 1500 mm.
21 Thrives in zones with precipitation levels between 350 and 1200 mm.
22 Bindi/Howden, 2008.



Levels of risk of water deficiency in consequence of climatically related changes to the water balance in the Florence region

Watering of citrus plants on an espalier in the Boboli Gardens

that has also been applied in the Moorish gardens of southern Spain,[23] or in the case of plants trained on espaliers, by means of overflowing micro-feeder streams supplied by single small channels. In the Medici gardens, and in the historic gardens of Central Italy generally, watering has been carried out by hand, with the water coming from subterranean feeds being scooped from collection basins, reservoirs or fishponds.

Final conclusions

With a view to an active and inventive approach to the conservation of historic sites, it will be important in the future to develop strategies which, on the one hand, avoid distorting the physiognomy of the historic garden, and on the other, do not lose sight of the necessity for limiting the consumption of water used for irrigation purposes. Research carried out to date, along with practical experience, indicates that – over and above the development of effective techniques to increase the efficiency of watering – one possible approach might be the use of specimens (even for the restoration of historic gardens) which have less need of water. This approach must be followed either through the use of other, philologically correct species, which have a similar form and phenology to the types of plant most commonly used, or simply by looking for supra-specific units (varieties, provenances, ecotypes etc.) which can show more effective water control. This will certainly be more feasible in the case of species that have a high degree of adaptability in relation to water, which are distributed over extended areas, altitudinal zones and/or latitudes.

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23 Cf. Galletti/Matteini, 2005.

Guido Moggi: The most important trees in Italian parks and gardens

Gymnosperms

1	■	↑		+	*Abies alba* Miller (silver fir)
1	■			–	*Abies* sp. pl. (various species)
1	■	↙	AN	–	*Calocedrus decurrens* (Torr.) Florin (incense cedar)
1	■	↙	AF	+	*Cedrus atlantica* (Endl.) Carr. (Atlantic cedar)
1	■	↙	AE	–	*Cedrus deodara* (Lamb.) G. Don (Himalayan cedar)
1	■	↙	AW	+	*Cedrus libani* A. Richard (cedar of Lebanon)
1	■	↙	AN	+	*Chamaecyparis lawsoniana* (Murr.) Parl. (Lawson cypress)
1	■	↙	AN	–	*Cupressus arizonica* E. L. Greene (Arizona cypress)
1	■	↑		+	*Cupressus sempervirens* L. (Mediterranean cypress)*
2	■			+	*Juniperus* sp. pl. (various species) (juniper)
1	■	↑		–	*Picea abies* (L.) Karsten (spruce)
1	■	↑		+	*Pinus halepensis* Miller (Aleppo pine)
1	■	↑		–	*Pinus nigra* Arnold (black pine)
1	■	↑		+	*Pinus pinea* L. (stone pine/parasol pine) *
1	■			+	*Pinus* sp. pl. (other species)
1	■	↙	AN	–	*Pseudotsuga menziesii* (Mirb.) Franco (douglasia, Douglas spruce)
1	■	↙	AN	+	*Sequoia sempervirens* (Lamb.) Endl. (coastal redwood/coastal wellingtonia)
1	■	↙	AN	–	*Sequoiadendron giganteum* (Lindley) Buchholz (giant redwood/sequoia)
1	✪	↙	AN	–	*Taxodium distichum* (L.) Richard (swamp cypress)
1	■	↑		+	*Taxus baccata* L. (common yew)
1	■	↙	AE	–	*Thuja orientalis* L. (oriental tree of life)

Angiosperms

1, 2	✪	↙	AU	+	*Acacia dealbata* Link (silver wattle/mimosa)
1	✪	↑		+	*Acer campestre* L. (field maple)
1	✪	↙	AN	+	*Acer negundo* L. (maple ash)
1	✪	↑		–	*Acer platanoides* L. (Norway maple)
1	✪	↑		–	*Acer pseudoplatanus* L. (sycamore)
1	✪	↙	EU	+	*Aesculus hippocastanum* L. (common horse chestnut)
1	✪	↙	=	–	*Aesculus x carnea* Heyne (red horse chestnut)
1	✪	↙	AE	–	*Ailanthus altissima* (Miller) Swingle (tree of heaven)
2	✪	↙	AE	–	*Albizia julibrissin* (Willd.) Dur. (sleeping tree/pink siris)
2	■	↑		–	*Arbutus unedo* L. (western strawberry tree)
1	✪	↑		–	*Betula pendula* Roth (silver birch)
2	✪	↙	AE	–	*Broussonetia papyrifera* (L.) Vent. (paper mulberry)
1	✪	↑		–	*Carpinus betulus* L. (hornbeam)
1	✪	↙	AN	–	*Catalpa bignonioides* Walter (southern catalpa)
1	✪	↑		+	*Celtis australis* L. (European nettle tree/hackberry)
2	✪	↑		+	*Cercis siliquastrum* L. (Judas tree)
2	■	↑		+	*Chamaerops humilis* L. (dwarf palm)
2	✪	↙	AE	–	*Chimonanthus praecox* (L.) Link (wintersweet/Japanese allspice)
1	■	↙	AE	–	*Cinnamomum camphora* (L.) Sieb. (camphor tree)
2	■		AE	+	*Citrus* sp. pl. (various species) (citrus plant)
1	✪	↙	AE	–	*Diospyros kaki* L. fil. (Kaki) (Japanese persimmon)
1	■	↙	AE	–	*Eriobotrya japonica* (Thunb.) Lindl. (Japanese loquat)
1	■	↙	AU	–	*Eucalyptus* sp. pl. (various species) (eucalyptus)
1	✪	↑		–	*Fagus sylvatica* L. (beech)
1	✪	↑		+	*Ficus carica* L. (fig tree)
1	✪	↑		–	*Fraxinus excelsior* L. (common ash)
2, 1	✪	↑		–	*Fraxinus ornus* L. (manna ash/flowering ash)
1	✪	↙	AN	–	*Gleditsia triacanthos* L. (American honey locust tree)
1	■	↑		+	*Ilex aquifolium* L. (European holly)
1	✪	↙	AN	–	*Juglans nigra* L. (black walnut)
1	✪	↑		+	*Juglans regia* L. (walnut)
2	✪	↑		–	*Laburnum anagyroides* Medic. (common laburnum)
2	✪	↙	AE	–	*Lagerstroemia indica* L. (crape myrtle)
1, 2	■	↑		+	*Laurus nobilis* L. (laurel)
2	■	↙	AE	+	*Ligustrum lucidum* Ait. fil. (glossy privet/Chinese privet)
2	✪ ■	↑		–	*Ligustrum vulgare* L. (common privet)
1	✪	↙	AN	–	*Liquidambar styraciflua* L. (American liquid amber)
1	✪	↙	AN	–	*Liriodendron tulipifera* L. (American tulip tree)
1, 2	✪	↙	AN	–	*Maclura pomifera* (Raf.) C. K. Schneider (osage orange)
1	■	↙	AN	+	*Magnolia grandiflora* L. (southern magnolia)
1	■ ✪	↙	=	–	*Magnolia* sp. pl. (various species)
1	✪	↙	AE	–	*Morus alba* L. (white mulberry)
2	■	↑		–	*Myrtus communis* L. (common myrtle)
2	■	↙	AE	–	*Osmanthus fragrans* (Thunb.) Lour. (fragrant olive)
2	■	↑		–	*Phillyrea latifolia* L. (broad-leaved mock privet)
1	■	↙	AF	+	*Phoenix canariensis* Chabaud (Canaries date palm)
1	■	↙	AW, AF	–	*Phoenix dactylifera* L. (date palm)

Angiosperms

2	■	↙	AE	–	*Photinia serratifolia* (Desf.) Kalkman (Japanese photinia/Chinese hawthorn)
2	■	↙	AE	–	*Phyllostachys bambusoides* Sieb. et Zucc. (bamboo)
2	■	↙	AE	+	*Pittosporum tobira* (Thunb.) Ait. f. (Japanese pittosporum)
1	✪			–	*Platanus hybrida* Brot. (London plane)
1	✪	↑		+	*Platanus orientalis* L. (oriental plane)
1	✪			–	*Populus* sp. pl. (various species) (poplar)
1	■	↙	EU, AW	+	*Prunus laurocerasus* L. (cherry laurel)
1	■	↙	EU	–	*Prunus lusitanica* L. (Portuguese cherry laurel)
1, 2	✪ ■			+	*Prunus* sp. pl. (other species)
1	■	↑		+	*Quercus ilex* L. (holm oak)
1	✪	↑		–	*Quercus petraea* (Matt.) Liebl. (durmast oak)
1, 2	✪	↑		–	*Quercus pubescens* Willd. (downy oak)
1	✪	↑		+	*Quercus robur* L. (common oak)
1	✪	↙	AN	+	*Quercus rubra* L. (red oak)
2	■	↑		–	*Rhamnus alaternus* L. (Italian buckthorn)
1	✪	↙	AN	+	*Robinia pseudacacia* L. (locust tree, pseudoacacia)
2	✪	↑		–	*Sambucus nigra* L. (elder)
1	✪	↙	AE	–	*Sophora japonica* L. (Japanese pagoda tree)
2	✪	↙	EU	–	*Syringa vulgaris* L. (lilac)
1	✪	↑		–	*Tilia cordata* Miller (winter linden)
1	✪	↑		+	*Tilia platyphyllos* Scop. (summer linden)
1	✪	↑		+	*Tilia x vulgaris* Hayne (common linden)
1	✪			–	*Tilia* sp. pl. (other species)
1	■	↙	AE	+	*Trachycarpus fortunei* (V. J. Hooker) Wendland (Chusan palm)
1	✪	↑		–	*Ulmus glabra* Huds. (mountain elm)
1	✪	↑		+	*Ulmus minor* Miller (field elm)
2	■	↑		–	*Viburnum tinus* L. (evergreen snowball)
1	■	↙	AN	+	*Washingtonia filifera* (Linden) Wendland (Washington palm)
2	✪	↙	AE	+	*Wisteria sinensis* (Sims) Sweet (wisteria)

1 *tall tree;* 2 *moderately tall tree, small tree or shrub*
■ *evergreen;* ✪ *deciduous*
↑ *species indigenous to Italy;* ↙ *Exotic* – for exotic species, the region of origin is shown as follows: AN = North America; AF = Africa; AW = Western Asia; AE = Eastern and Southeast Asia; AU = Australia; EU = Europe
+ – *cultivated species which is frequently* (+) *or less frequently* (–) *found in the gardens*

Anmerkungen: Gen. *Cedrus* (cedar): hybrids also occur between the three species · *Cupressus sempervirens**: allochthonous species, but introduced to our country in ancient times, so that it may be regarded as indigenous · The greater or less frequent occurrence (+/–) also depends on the climatic conditions of the gardens.

Citrus in the Orto segreto of the park at Villa Reale, Castello