ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΓΕΩΤΕΧΝΙΚΟ ΕΠΙΜΕΛΗΤΗΡΙΟ ΕΛΛΑΔΑΣ
ΠΑΡΑΡΤΗΜΑ ΠΕΛΟΠΟΝΝΗΣΟΥ &
ΔΥΤΙΚΗΣ ΣΤΕΡΕΑΣ ΕΛΛΑΔΑΣ

Ταχ. Δ/νση : Γεροκωστοπούλου 24, Πάτρα
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Πάτρα: 13-10-2022
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ΚΟΙΝ. **κα. Αιμιλία Σκούρα**

ΘΕΜΑ: «Διαβίβαση κειμένου επισημάνσεων Παραρτήματος ΓΕΩΤ.Ε.Ε. επί Μελέτης «Αστικές Δενδροφυτεύσεις Μεγάλης Κλίμακας» του Τ.Ε.Ε. Δυτικής Ελλάδας»
ΣΧΕΤ.: «Αστικές Δενδροφυτεύσεις Μεγάλης Κλίμακας» - Μελέτη Τ.Ε.Ε. Δυτ. Ελλάδας

Αξιότιμε κύριε Πρόεδρε,

Σε συνέχεια της Μελέτης «Αστικές Δενδροφυτεύσεις Μεγάλης Κλίμακας» που εκπονήθηκε από Επιτροπή του Τ.Ε.Ε. Δυτικής Ελλάδας και καθότι αυτή αφορά σε γεωτεχνικό αντικείμενο, το Παράρτημα Πελοποννήσου & Δυτικής Στερεάς Ελλάδας του ΓΕΩΤ.Ε.Ε. σας παραθέτει ακολούθως επισημάνσεις που έκανε επί του κειμένου της Μελέτης η Γεωπόνος-Αρχιτέκτονας Τοπίου και μέλος του Παραρτήματος κα. Αιμιλία Σκούρα και οι οποίες εγκρίθηκαν ομόφωνα στην υπ' αριθμ. 7/12-10-2022 συνεδρίαση της Δ.Ε. του Παραρτήματος.

Η μελέτη «Αστικές Δενδροφυτεύσεις Μεγάλης Κλίμακας» είναι μία αξιόλογη προσπάθεια αντιμετώπισης του ζητήματος του αστικού πρασίνου που στοχεύει στη διαχείριση θεμάτων σχετιζόμενων με:

- Τη «Μείωση Αστικής Θερμικής Νησίδας και Ενεργειακής ζήτησης κτιρίων»,
- Την «Αύξηση Θερμικής Άνεσης των πεζών»,
- Τη «Μείωση των Ρύπων»,
- Της «Απόσβεσης της Ηχορύπανσης και της Οπτικής όχλησης» και
- Της «Μείωσης του κινδύνου πλημμύρας».

Από γεωτεχνικής σκοπιάς και προκειμένου για μια πιο ολοκληρωμένη και συνεκτική αντιμετώπιση του ζητήματος, θα προτείναμε η μελέτη να είχε επεκταθεί στην περιβαλλοντική/γεωτεχνική πλευρά του ζητήματος των αστικών δενδροφυτεύσεων αλλά και να είχε προνοήσει για την επίπτωση της κλιματικής αλλαγής στις προτεινόμενες παρεμβάσεις, αφού ο σχεδιασμός είναι μακροπρόθεσμος.

Από περιβαλλοντικής πλευράς, οι αστικές δενδροφυτεύσεις έχουν σημαντικές καλλιεργητικές και διαχειριστικές διαστάσεις γεωπονικού αποκλειστικά αντικειμένου. Όπως θα δείτε στην αντίστοιχη μελέτη (επισυναπτόμενη) για την αστική περιοχή της Βαρκελώνης (Street Tree Management in Barcelona), το μεγαλύτερο μέρος αντίστοιχων μελετών αφιερώνει ιδιαίτερα κεφάλαια σε θέματα που σχετίζονται με:

- Επιλογή ειδών για δενδροφύτευση ανά μικρο-περιβαλλοντική θέση και σκοπό
- Εποχές και χρόνους φύτευσης
- Μεθόδους φύτευσης
- Άρδευση και διαχείριση νερού
- Κλαδεύσεις
- Φυτο-υγειονομικά και φυτο-προστατευτικά μέτρα

Για παράδειγμα, στην επιλογή φυτών, η μελέτη προτείνει Ακακία η οποία όμως λόγω πολύ έντονης ανθοφορίας ενισχύει τις αλλεργίες. Ενδεχομένως, μια καλύτερη επιλογή να είναι οι κουτσουπιές ή οι χαρουπιές, παρά τον καρπό τους. Επίσης προτείνεται στη μελέτη φύτευση μουριάς (Morus Alba Fruitless ή Fruitless White Mulberry) όπου θα πρέπει να χρησιμοποιηθεί το είδος χωρίς καρπούς. Επίσης δεν υπάρχει διαχωρισμός σε αειθαλή και φυλλοβόλα. Τα αειθαλή δεν θα πρέπει να χρησιμοποιούνται σε θέσεις που το χειμώνα θέλουμε φυσικό φωτισμό.

Για τα σχολεία έχει υπολογιστεί φύτευση 1 δέντρο/5μ. περιμετρικά του προαυλίου ενώ για τους σταθμούς έχει τεθεί συντελεστής φυτοκάλυψης 0.5 επί του συνολικού εμβαδού. Αυτό, εξαρτάται εάν κανείς θέλει να επιτύχει αραιή ή πυκνή φύτευση και για ποιο λόγο. Επιπρόσθετα, μεγάλη προσοχή πρέπει να δοθεί στα είδη που θα προταθούν για τα σχολεία και ιδιαίτερα τα νηπιαγωγεία-δημοτικά σε σχέση με πιθανές αλλεργίες, επικινδυνότητα από αγκάθια και βρωσιμότητα των καρπών.

Στις φυτεύσεις, η μελέτη προτείνει συγκεκριμένες διαστάσεις διατομής, όμως γία κάθε δέντρο απαιτείται διαφορετικό μήκος και πλάτος διατομής (από 1.5-4m). Το δε βάθος αλλάζει ανάλογα με το μήκος της ρίζας του φυτού. Τα επιπολαιόριζα είδη πρέπει να αποφεύγονται διότι μπορούν να προκαλέσουν καταστροφές στο παρακείμενο οδόστρωμα ή πλακόστρωση πεζοδρομίου.

Από πλευράς κλιματικής αλλαγής οι δενδροφυτεύσεις έχουν μεγάλη διάρκεια ζωής σε βαθμό που, οποιαδήποτε προβλεπόμενη αλλαγή στο κλίμα ιδιαίτερα με τα σενάρια μέχρι το 2050 ή και αργότερα, θα έχει επιπτώσεις στα φυτά σε ώριμη ηλικία. Οι προβλεπόμενες επιπτώσεις και κυρίως η συχνότερη εμφάνιση ακραίων καιρικών φαινομένων θα δοκιμάσουν τα ώριμα φυτά ως προς τις αντοχές τους κυρίως σε παρατεταμένη περίοδο υψηλών θερμοκρασιών αλλά, ενδεχομένως, και ισχυρών ανέμων που θα δοκιμάσουν τις μεθόδους φύτευσης και στήριξης των φυτών αλλά και επιλογής φυτών με βάση το ριζικό σύστημα, κλπ.

Αυτού του είδους οι μελέτες θα ήταν σκόπιμο να εκπονούνται από διεπιστημονικές επιτροπές έτσι ώστε να προσφέρουν μια ολοκληρωμένη και ολιστική προσέγγιση στο θέμα των αστικών δενδροφυτεύσεων και για τους σκοπούς που αναφέρονται παραπάνω.

Ακριβές Αντίγραφο
Σοφία Καϊτη

Για τη Διοικούσα Επιτροπή
Ο Πρόεδρος

Αθανάσιος Πετρόπουλος
Γεωπόνος

Συν/να: Μελέτη «Street Tree Management in Barcelona»

Street Tree Management in Barcelona

Ajuntament de Barcelona

Street Tree Management in Barcelona

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December 2011

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Department of Green Area Management
Department of Knowledge Management
Department of Environmental Education

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Historical Archive of Barcelona
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Print
www. print-makers.com

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Managing a natural heritage

Taking a stroll at midday in summer in Barcelona would be a torture if there were no trees in the streets. In a Mediterranean city like this one, trees moderate the temperatures and make public spaces more user-friendly with their shade and cool, and they mark the rhythm of the seasons and add colours and scents to the urban landscape. At the same time, although it is not so noticeable, they help to clear dust and purify the air we breathe.

Even so, we often don't notice the trees in the street until one day, suddenly, a jacaranda, a lime or an Indian bead tree surprises us with the gift of its flowers and scents. And without trees the city would be unrecognisable. They are, together with the parks and gardens, Barcelona's great green heritage; an invaluable heritage that must be looked after carefully to guarantee its conservation and improvement.

The guide you have in your hands is intended to draw attention to the role of trees in the city, especially in the current context of climate change, and explain how they are managed to obtain greater benefits, while trying to apply a universal maxim in the world of arboriculture: "The right tree in the right place."

You will also find the principles that constitute the basis of street tree management in Barcelona. These are as follows:

Firstly, sustainability, with a selection of species suited to the environmental conditions and intended to increase diversity by ensuring no one species exceeds 15% of the total. The reasoning behind this objective, which is being achieved gradually, is to avoid monospecific populations vulnerable to pests and diseases.

Secondly, the creation of a diverse and identifiable landscape: every street, every neighbourhood is unique, and trees help to reaffirm this identity. For example, the main streets in the Eixample are associated with the London plane, just as palm trees help to identify the coastline and ring roads.

And lastly, knowledgeable and efficient management, which is needed to protect our tree heritage by taking advantage of new technologies that allow us to unify our efforts and save resources.

I hope this handbook will help you to learn more about the trees on the streets of Barcelona, which play a major role in our welfare, and the work of the specialists responsible for their daily care, whom I would like to thank for their efforts and commitment.

Preamble

Few images more clearly identify Barcelona than the Eixample district with its tree-lined streets. The people of Barcelona lay great importance on this natural heritage. An example of this is that when we want to commemorate an act or an event or keep alive a memory, we often choose to do so by planting a tree, a living organism.

That trees are essential in a dense compact city like Barcelona is also confirmed by city council policy, which is committed to increasing the number and quality of trees in the streets in view of the many social and environmental benefits they bring to the city. Therefore, it is no coincidence that the Barcelona Charter, the "Declaration of **the Rights of Trees** in the City", was drawn up and signed in Barcelona on the occasion of the first congress of the Spanish Association of Arboriculture. This Charter establishes the rights of trees in the urban environment. It recognises them as one of the essential factors "guaranteeing the life" of the city and requires that their introduction "should be given maximum attention". It also requires that the network of trees "should be evaluated, planned and managed", and affirms that "they help to establish culture at a local level and improve living conditions in the urban environment".

Since it was presented, a large number of towns around Spain have signed the Barcelona Charter. It establishes the following commitments:

Commitments contained in the Declaration of the Rights of Trees in the City

- To situate trees in their basic role as one of the city's principal heritage resources.
- Comprehensive and continuous preparation and promotion of information, inventories, management techniques, practices, procedures, products, services and standards that facilitate the introduction of trees in the city in fitting and decent conditions.
- To disseminate information: to inform and educate the general public, the various professional groups, the industrial and service sectors, schools, colleges and universities, about the basic importance of trees for life in the city.
- To establish policies, rules, regulations and practices in city government and administration that ensure optimal conditions for the life of trees.
- To reconsider all the elements that currently make up urban space and think ahead from the standpoint of the requirements and potential of the urban tree network as regards the conception, planning, creation, management, use and reuse of this public space.

I. The Urban Tree

1. Some historical notes

The first trees to be planted

The Rambla was the first public place – of which there is any record – to be planted with trees. In 1702 and 1703, 280 poplars were planted, which were cut down shortly after and replaced with alternating poplars and elms.

In the description of the tree-planting project drafted by the counsellors Germán de Salvador and Carles Arnau it is explained that:

"As the main decoration in the Rambla itself, the planting in it of lines of leafy trees of different species is necessary, as in other cities and towns which are the wonder of all Europe and admired by foreigners and inhabitants alike, and the same as the four lines of trees that have already been planted from the street known as Carrer de la Adressana to the corner of the Carrer de Escudellers, which are irrigated with great ease with the water moved by three waterwheels and the well in the convent of Santa Monica, aided by the device of a pump. And being universally acclaimed in all respects by people both high and humble, there emerges the particular obligation to continue them along the whole Rambla, even more so as the clemency of the weather favours the planting of trees, and there is equally well good recourse to water for irrigation." (Carreras Candi, 1916)

The Passeig de Gràcia

According to Joan Villoro in the book *Guia dels espais verds de Barcelona* (Guide to green spaces in Barcelona), the first example of a street with lines of trees included in its urban planning project was the Passeig de Gracia, which was then the main route into the city:

"The work on this boulevard began in 1821, and as time went by, several gardens for the enjoyment of the people of Barcelona were laid out along its sides. This street was already mentioned in 1760 as one of the main avenues, and in 1826 they planted acacia, plane trees, ash, mulberry trees, poplars, willows, oleanders [sic], and some holm oaks probably coming from the farms round about, such as the one still existing today in front of number 103." (Villoro i Martin, 1984)

The Cerdà Plan

In 1854, Barcelona's old city walls were demolished and it was necessary to plan the development of the area extending as far as the surrounding villages. In 1859 the Cerdà Plan was approved, which proposed the "Eixample", an expansion of the city stretching from Montjuic to the River Besòs, with an orthogonal layout consisting of rectilinear streets twenty metres wide, forming a grid of square blocks 113.3 metres long on each side.

Cerdà, following the fashion of most other European cities – for example, Paris and its boulevards planned out by Haussmann and Alphand – decided that the major avenues and streets in the Eixample should be lined with large trees planted to provide shade in the city, with a tree every eight metres. Moreover, according to the original plans one of the four pavements delineating each block was meant to be twice as wide and would therefore have had a double line of trees.

However, during the time it took to build the Eixample – about a century – the modifications made to the plan conflicted with the initial project and many of the original ideas were never implemented. Thus, as the construction of the Eixam-

Passeig de Gràcia, 1953

Cross-section of fifty-metre-wide streets. Historical Archive of Barcelona

ple progressed, the projected planting of street trees became an issue of secondary importance.

The ideas of Rubió i Tudurí

In the second and third decades of the 20th century, the responsibility for public gardens in the city lay in the hands of Nicolau Maria Rubió i Tudurí, who designed many of the squares and gardens in Barcelona dating from that time. As far as the trees were concerned, he paid particular attention to the search for new trees in order to select species better adapted to the city. For example, he it was who introduced such successful species as the tipu tree (*Tipuana tipu*) and the jacaranda (*Jacaranda mimosifolia*). He also did informative work, publishing a series of articles where he reflected on the always open conflict between the advance of urbanisation and vegetation, especially with regard to street trees, and noted that pavements, even in his time, had the drawback of making the ground impermeable, which is detrimental to filtration of rainwater and its availability for street trees.

The Eixample street tree management plan

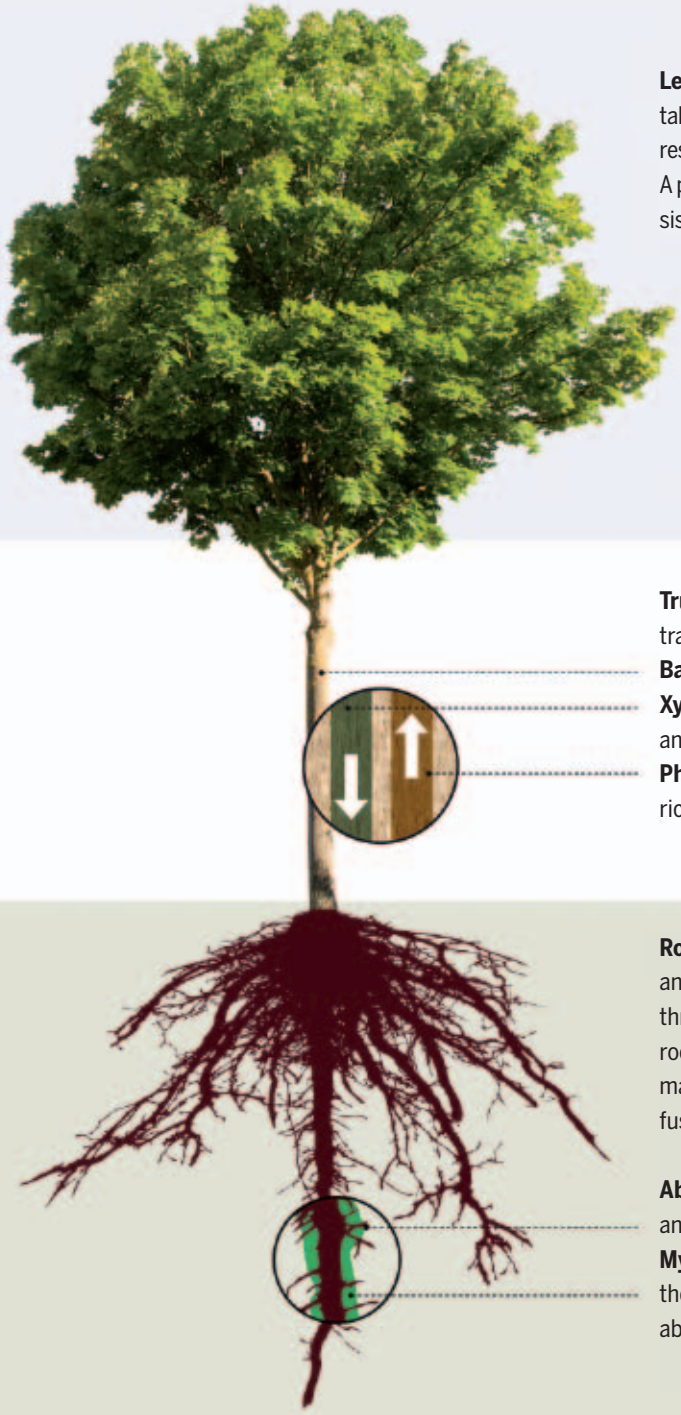
In 1998, Barcelona City Council drafted a plan for street tree management in the Eixample. This district had the highest proportion of trees in the city, with a clear predominance of plane trees. These were displaying clear signs of aging and there was a high percentage of diseased specimens.

This plan included the guidelines set out in Barcelona's Plan for Green Spaces (1995), which had already pointed out the need for a programme to manage the replacement of some species of street trees. The idea was to ensure a better balance between the different species without affecting the identity of consolidated urban spaces. The Eixample tree management plan took into consideration factors that have become very important in modern urban gardening, such as sustainability and biodiversity. It also served as an instrument that gathered together the guidelines for street tree management and maintenance in Barcelona. The plan for the Eixample evolved into Barcelona's current management plan for street trees.

2. How do trees function?

To understand how trees function it is important to know the basic details of their physiology.

The tree as a living organism consists of the parts above and below the ground, the latter occupied by the roots. Although the depth and extension of root systems is very variable, this system usually occupies a space equivalent or superior to that above ground.



Leaves: where transpiration and evapotranspiration take place (oxygen and evaporated water). They are responsible for the production of organic matter,
A part of solar energy used (1 to 3%) goes to synthesise chlorophyll.

Trunk: A complex system of vessels that serves to transport sap.
Bark
Xylem vessels → transport: ascending flow (water and mineral nutrients)
Phloem vessels → transport: downward flow (sap rich in sugars made by photosynthesis)

Roots: responsible for fixing the tree to the ground and the absorption of water and mineral nutrients through non-woody roots (absorbent hairs). The root system can be central (with a single vertical main root from which secondary roots grow) or diffuse (made up of several main roots).

Absorbent hairs: responsible for absorbing water and mineral nutrients
Mycorrhizae: fungi that grow on the roots and thereby increase the surface area available for the absorption of water and nutrients

3. Trees and the environment

The city does not usually offer trees ideal living conditions. The growth of a tree planted on the street displays important differences as compared to a tree of the same species and age planted in natural conditions, or even planted in a green space in a city.

Soil conditions directly affect the growth of street trees. When soil is too compact, due to the weight of asphalt, pavements, vehicles and so on, this results in a reduction in oxygen levels and the ensuing asphyxiation of the roots and the mycorrhizae responsible for nutrition. The same thing happens when the soil is flooded for a long period of time.

Furthermore, as the years go by, the soil in tree pits deteriorates in quality, mainly due to the absence of fallen leaves and dead wood. Therefore, the soil becomes impoverished; it lacks organic matter and the microorganisms that break it down, causing a chemical imbalance in the soil. If this is compounded by a shortage of available water – because most rainwater flows directly into the sewers due to the impermeability of the soil – the result is a tree with a stunted root system.

In normal conditions rainwater is very beneficial to trees, but after long dry periods in the city the rain that falls flushes out the oil, petrol and heavy metals that accumulate in the streets, mainly produced by vehicles, so that when it filtrates into tree pits it is relatively polluted and may affect growth. Other aggressive agents that can harm trees are dog urine, which burns into the bark at ground level, and detergents and other toxic products that are often poured into tree pits and cause damage.

The urban environment also contains a series of atmospheric pollutants that may cause damage to trees. For example, there is a great deal of dust in Barcelona. Dust particles are filtered by trees but in excessive amounts they form a layer on the leaves and impede the absorption of light. The trunk and branches are also a vulnerable part of the tree, and any blow, bad pruning or burn that leaves a mark may affect its physiology and create a gateway for pathogens, infectious bacteria and fungi.

Trees in the urban environment already have a shorter life and smaller dimensions than in the natural environment and these attacks further weaken the tree and reduce life expectancy.

El arbolado tiene un papel destacado en el metabolismo de la ciudad y proporciona una serie de beneficios ambientales y sociales que se resumen a continuación.

Judas tree (*Cercis siliquastrum*). Ciutat de la Justícia (Barcelona Law Courts)

4. Some good reasons for planting trees

Trees play an important role in the functioning of the city and provide a series of environmental and social benefits that are summarised below.

Environmental benefits

Improved air quality

Urban vegetation, particularly trees, helps keep the air clean by removing atmospheric pollutants – mainly generated by traffic and industry – such as ozone, sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter.

Tipuana (*Tipuana tipu*). Montbau

Trees produce oxygen, an element essential to life on Earth, and also absorb carbon dioxide (CO_2) from the atmosphere during growth, produced mainly by vehicles, industry and heating. As the years go by, trees store large amounts of CO_2 in their tissues and in this way reduce greenhouse gases involved in global warming by a significant amount.

Climate control

Vegetation, particularly trees, tempers climatic conditions and modifies the urban microclimate, mainly by cooling through shade and transpiration. In addition, the reflection of sunlight by the leaves lowers the temperature in pedestrian areas and the shade protects people from the sun, especially during the hottest months.

Reduction of noise pollution

Trees, and plants in general, help to attenuate noise pollution in several ways: by absorption, diversion, reflection and refraction of sound, which reduce the reverberation caused by the noise of cars on the facades. They also have the particularity of muffling annoying sounds while making agreeable ones.

Regulation of the water cycle in the city

Trees help to reduce the amount of storm water runoff and prevent possible flooding, as each part of a tree, and the permeable soil below it, retains significant amounts of rainwater. The roots also fix the soil and thus prevent erosion.

The leaves, trunks and roots of trees retain pollutants and therefore reduce their concentration in waterways.

Increase in biodiversity
The planting of different species of street trees, especially species bearing fruit at different times of the year, increases urban vegetal biodiversity and provides food and shelter for many animals, especially birds.

Social benefits

Trees contribute to good mental health by improving people's quality of life and wellbeing and establishing links between people and nature.

Trees create individual landscapes and contribute shapes, colours and seasonal variability that help define streets and even whole neighbourhoods. They also give homes greater privacy and serve as structural elements for creating a diversity of environments.

An significant number of street trees in Barcelona consists of adult trees planted many years ago, some of which are listed in the catalogue of trees of local interest, i.e. they are part of the city's history and in some cases, together with the existing architecture, determine the character of certain emblematic streets. Would the Rambla be the same without its plane trees? All in all, trees are a reminder of the city's history.

Economic value

Trees (especially large ones) help to make the city more beautiful and increase the value of homes.

The shade and microclimate generated by street trees reduces the amount of energy consumed by air conditioning in adjacent buildings and, as a direct result, the cost of air conditioning in homes, especially on the lower floors.

Some facts and figures about Barcelona

In the study of the ecological benefits of urban green areas in Barcelona (2009), carried out by the CREAF (Centre for Ecological Research and Forestry Applications) on the request of Barcelona City Council, the environmental benefits of trees in the city were evaluated. Some of the data obtained are as follows:

▸ In one year the trees in Barcelona are able to remove more than 305 tons of air pollutants, made up of 5 tons of carbon monoxide (CO), 55 tons of nitrogen dioxide (NO_2), 72 tons of ozone (O_3), 166 tons of particles smaller than 10 mm (PM_{10}) and 7 tons of sulphur dioxide (SO_2).

▸ In Barcelona, the annual storage of carbon in trees amounts to about 113,437 tonnes. The net carbon stored (after absorbing the carbon released by decomposition) is 5,422 tons per year.

▸ The formation of volatile organic compounds (VOCs) may have a negative impact on air quality, since these compounds contribute to the formation of O3 and CO. The VOCs emitted annually by the trees in the city amount to 184 tons.

5. How are the species chosen?

In general terms there are many tree species worth planting in the urban environment. The choice depends on many factors, according to what is needed: shade, showy flowers, scents, certain shapes and sizes, and so on. It should be remembered, however, that certain species have negative effects and, therefore, when selecting new trees for planting, certain traits must be taken into account: allergies, fruits that leave a mess on the ground, easily breakable branches, invasive potential, and so forth.

Criteria for species selection

Climate
Native species or those well adapted to the Mediterranean climate are best. This allows for healthier, more resilient specimens that need less maintenance and save on resources, while also having a better natural appearance. In short, the species best adapted to the environment are selected.

In recent years species selection has also taken into account the forecasts on climate change in the Mediterranean area, with an expected increase in temperature and uneven rainfall distribution.

The surroundings
The available space determines how trees grow. Depending on how close they are to buildings, the width of the street and the pavements, the volume of vehicle and pedestrian traffic and so on, appropriate species are selected in terms of the size of the tree, i.e. the diameter of the crown and height of the adult tree. This cuts down on the need for pruning and lengthens the life of the tree.

Sustainability
Each tree species offers a series of environmental benefits. Examples are the selection of species for large avenues capable of retaining large quantities of dust and other pollutants produced by traffic, or the choice of shade trees that cool the air in summer, especially in areas with a lot of pedestrians.

Increasing the diversity of trees in the city and making sure that the selected species do not exceed 15% of the total number of street trees not only makes for a greater biodiversity of trees but also of associated fauna. And an increase in tree diversity in the city reduces their vulnerability to pests and diseases.

Public-friendliness
It is important to choose species that do not cause any inconvenience. Trees that have thorns, cause allergies or break easily are best avoided.

Longevity
The urban habitat does not favour the growth of trees and significantly shortens their lives. To make sure the landscape created with trees lasts as long as possible, more durable species are selected.

Seasonal variations
The seasonal changes in trees can be aesthetically pleasing and also help to identify the place where they grow. For this reason, the selection process takes into account flowering time, whether species are deciduous or evergreen, changes in leaf colour, textures, bark patterns and colours, and also the smells trees give off.

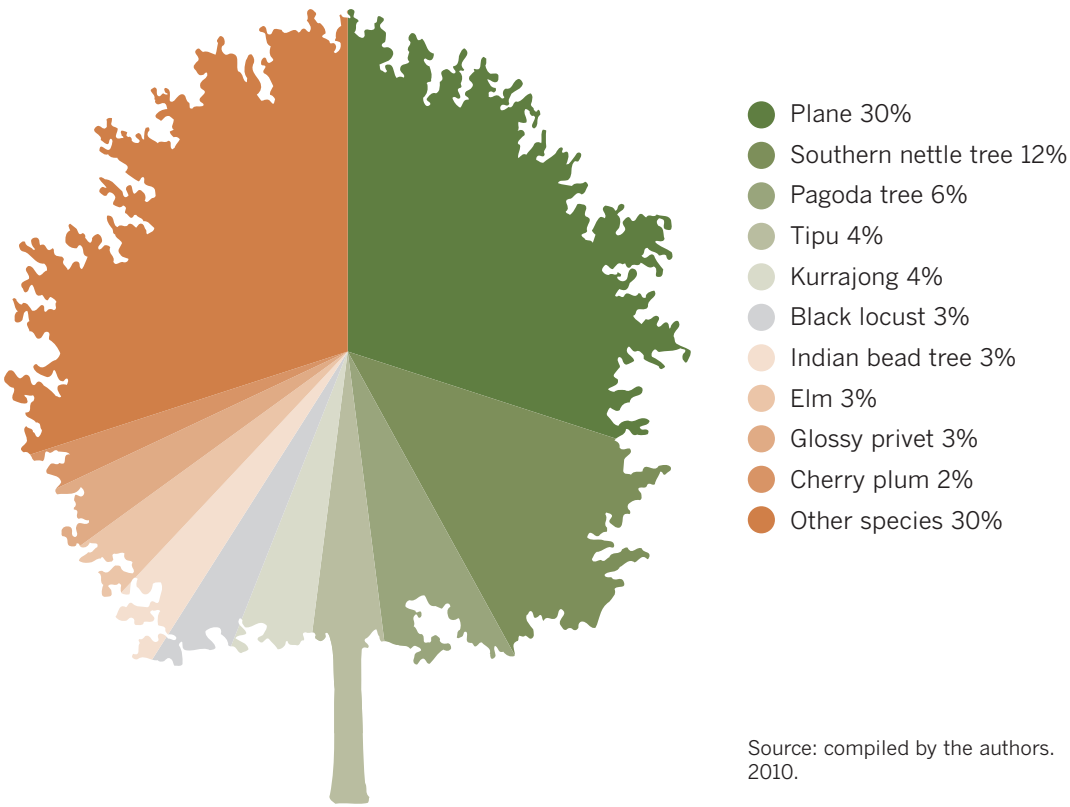
6. Breakdown of street trees in Barcelona

There are over 150,000 trees in the streets of Barcelona and their management is a city council priority. The aim is to build up a comprehensive green network in order to improve the quality of life in the city.

Taking the city as a whole, the most common species in the city streets today are planes, southern nettle trees and pagoda trees. Among the palm trees, the date palm is the most numerous.

For many years the predominant species on the streets of Barcelona was the plane tree and this monoculture made the city's tree population much more vulnerable. In 1995 Barcelona City Council introduced a programme to replace certain species of street trees. One of its main goals was to increase diversity through the introduction of new species better adapted to the conditions of the urban environment. This goal is reflected in the gradual substitution of London planes (Platanus x acerifolia), which have only been conserved on big avenues and in emblematic spaces, and the replacement of certain problematic species unsuited to the city such as the Siberian elm (Ulmus pumila), box elder (Acer negundo), black locust (Robinia pseudoacacia) and tree of heaven (Ailanthus altissima), which is an invasive species.

Tree species in Barcelona



Source: compiled by the authors. 2010.

An example of diversification is the planting of species with colourful flowers on street corners in the various neighbourhoods of the Eixample district: pagoda trees (*Styphnolobium japonicum*), Judas trees (*Cercis siliquastrum*), limes (*Tilia sp.*), Indian bead trees (*Melia azedarach*) and jacaranda (*Jacaranda mimosifolia*).

As for the size of street trees, in order to facilitate maintenance they are grouped into four categories in Barcelona, depending on the circumference of the trunk (measured one metre above the ground line). In the case of palm trees this classification depends on the height of the trunk instead.

Currently, 47% of the trees belong in the second category, 27% in the first, 21% in the third and 5% in the special category.

Among the palm trees, 51% belong in the second category, 28% in the third, 19% in the first, and 2% in the special category.

Dimensión de árboles y palmeras según el tronco

	1st category	2nd category	3rd category	Special category
Trees: trunk circumference	Up to 40 cm	Between 41 and 80 cm	Between 81 and 110 cm	Over 110 cm
Palm trees: trunk height	Up to 4 m	Between 4 and 8 m	Between 8 to 15 m	Over 15 m or unusual size

To facilitate tree maintenance in Barcelona the following classification is used:

- **Street trees:** trees in built-up areas, mainly in tree pits and in lines, growing close to buildings and/or the kerb, and needing more pruning maintenance than other types.
- **Open-space trees:** trees in built-up areas, especially in flowerbeds or gravel, whose situation does not affect buildings or traffic, so pruning is less frequent and differs from that of street trees.
- **Park trees:** trees located in parks or gardens, or courtyard inside blocks, needing similar maintenance to open-space trees.
- **Trees in natural areas:** trees growing in natural conditions, i.e. wooded areas, usually away from paths in parks or green areas, which require special pruning adjusted to these conditions.

Pagoda tree (*Styphnolobium japonicum*)

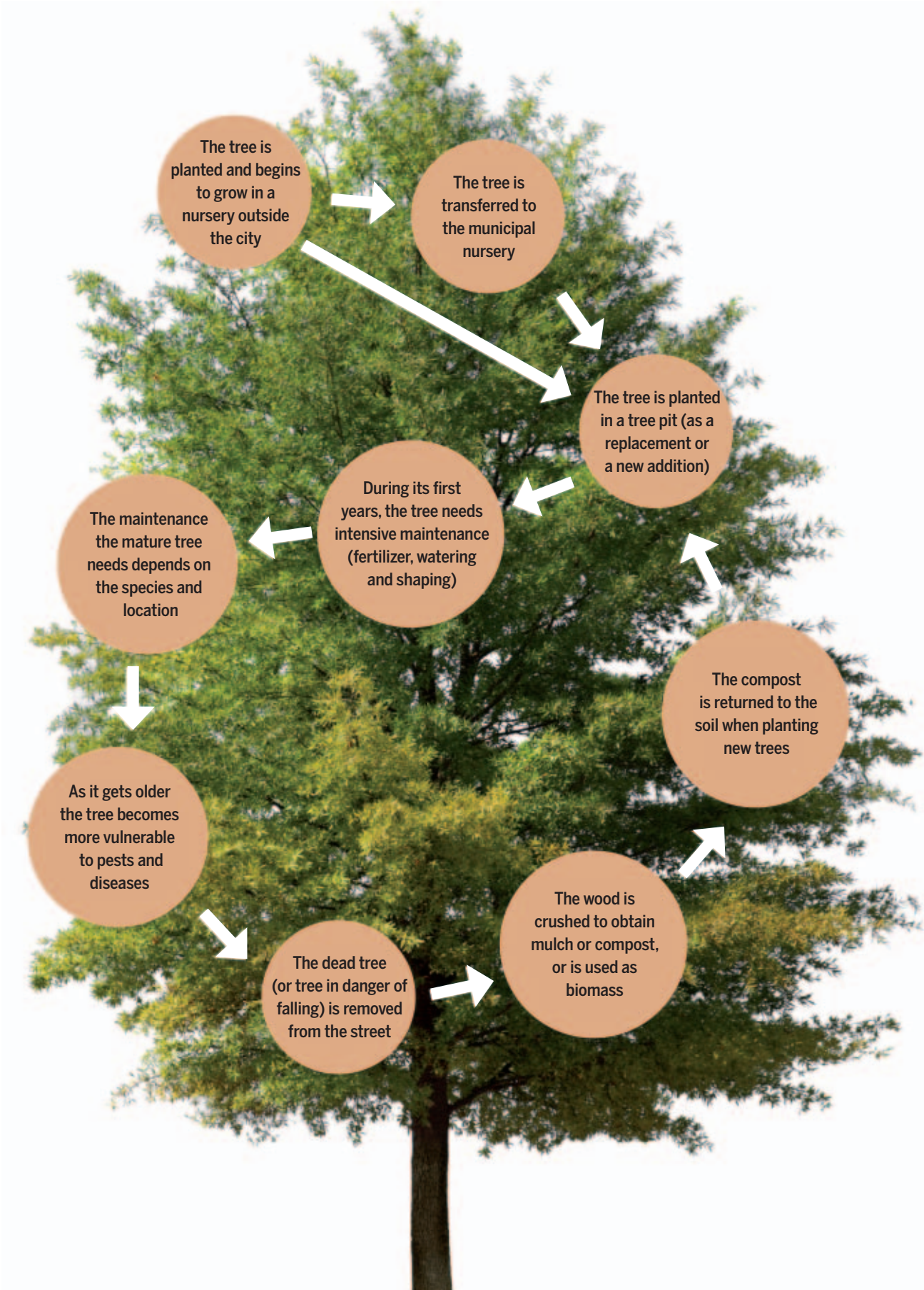
Judas tree (Cercis siliquastrum)

Lime (Tilia x euchlora)

Indian bead tree (Melia azedarach)

Jacaranda (Jacaranda mimosifolia)

7. The lifecycle of a tree in Barcelona



II. Street Tree Management in Barcelona

8. Management basics

Street tree management in Barcelona is based on three principles: sustainability, the creation of a varied and distinctive landscape, and safe and efficient management. Accordingly, the main lines of action involve:

• Selection of species adapted to the environmental conditions.

• Gradual increase in the biodiversity of the trees in the city. A maximum of 15% of trees of the same species.

• Street trees that create a more diverse landscape, with more variety in shapes, scents, colours and tones of both the leaves and the flowers, which helps to attract associated fauna.

• Creation of distinctive landscapes in certain neighbourhoods or districts to give them a stronger identity so that the inhabitants recognise and consider them as their own.

• Planning of planting and maintenance of street trees using standardised protocols.

• Criteria for respectful tree maintenance and use of integrated measures for pest and disease control. Greater respect for the tree and the environment.

• Rational use of water, by installing drip irrigation or drawing water from the subsoil.

• Use of new technologies that unify efforts and save resources.

• Introduction of environmental management systems (EMS) and health and safety management systems for personnel.

ISO 14001

Since 2001, Barcelona City Council has implemented an environmental management system with UNE-EN-ISO 14001-04 certification in the field of management and maintenance of public green areas and street trees.

This environmental management system provides protocols for planning, reviewing and monitoring the necessary operational controls (planting, pruning, tilling and risk assessment). It takes into account technical criteria for management and environmental responsibility and evaluates the successful outcome of the activities in situ, as well as the various secondary positive and negative effects. This system entails management based on criteria of effectiveness and efficiency.

Jacaranda (*Jacaranda mimosifolia*). Ciutat Vella district

Avda. Diagonal. Eixample district

9. The right tree in the right place

The size of the tree is one of the most important factors when choosing the appropriate species. Size is determined by two parameters: the diameter of the crown and the height of the adult tree.

The viability of the presence of trees in different city streets is determined by the characteristics of the street: the width of the pavements, the existence of vehicle traffic and intersections, street visibility and also existing services and pedestrian accessibility. Because of the limited space available in streets – the competition for space above and below ground – trees should only be planted when their proper growth is ensured.

The different types of streets in the city, from alleys to wide avenues, have very different arrangements of trees: in single, double or multiple rows.

In Barcelona, trees are classified according to their size:

Small tree:
diameter of crown less than 4 m and height less than 6 m

Medium-sized tree:
diameter of crown between 4 and 6 m and height between 6 and 15 m

Large tree:
diameter of crown greater than 6 m and height over 15 m

Guidelines for planting

The planting guidelines define the minimum distance between trees so that they do not interfere with services in the city streets but have enough space to grow properly. Good planting reduces maintenance.

In Barcelona, the streets are divided into three types depending on the width of the pavements, and different planting guidelines are applied in each case:

Avda. Diagonal. Sant Martí district

Narrow streets: those with a pavement width of less than 3.5 meters, where small species are planted. Planting on pavements less than 2.5 m wide should be avoided.

When buildings have balconies or overhangs and the crown of the adult tree would be expected to come within 0.5 m, planting should be avoided. The minimum distance between trees and lamp posts should be 3 m, and 7 m the planting distance between trees.

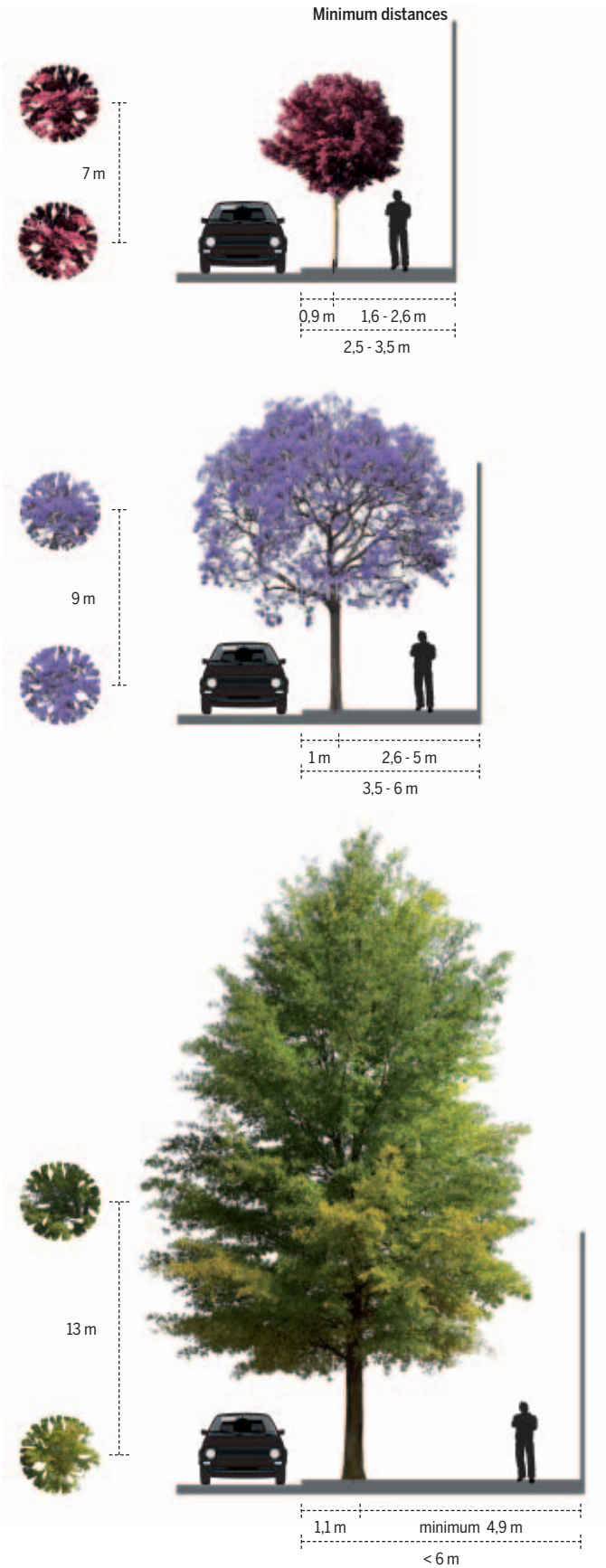
Medium-width streets: those with a pavement width of between 3.5 and 6 m, where medium-sized trees can be planted.

The minimum distance between trees and lamp posts should be 4.5 m, and 9 m the planting distance between trees.

Wide streets: those with a pavement width of more than 6 metres, where large trees can be planted.

The minimum distance between trees and lamp posts should be 6.5 m, and 13 m the planting distance between trees.

In all cases, the distance between trees and traffic lights and other signs must be greater than 3 m, and greater than 1 m between trees and dropped kerbs.



Tree pit design

Tree pits are the holes where trees are planted, the openings in the hard, unbroken pavement that constitute the physical space where the tree's root system develops. In the city there are basically two types of tree pit, individual ones – the most common – and expanded ones. The latter, possessing a greater permeable surface area, are better for trees.

Individual tree pits

The bigger the tree pit, the better for the tree. However, it is the width of the pavement that ultimately determines their size. Depending on the pavement, the useful surface area and minimum dimensions of tree pits are as follows:

In narrow streets tree pits should have a minimum surface area of 1 m^2 (0.8 x 1.2 m).

In medium-sized streets this should be 1 m^2 (0.8 x 1.2 or 1 x 1 m).

In wide streets it should be 1.5 m^2 (1.2 x 1.2 m).

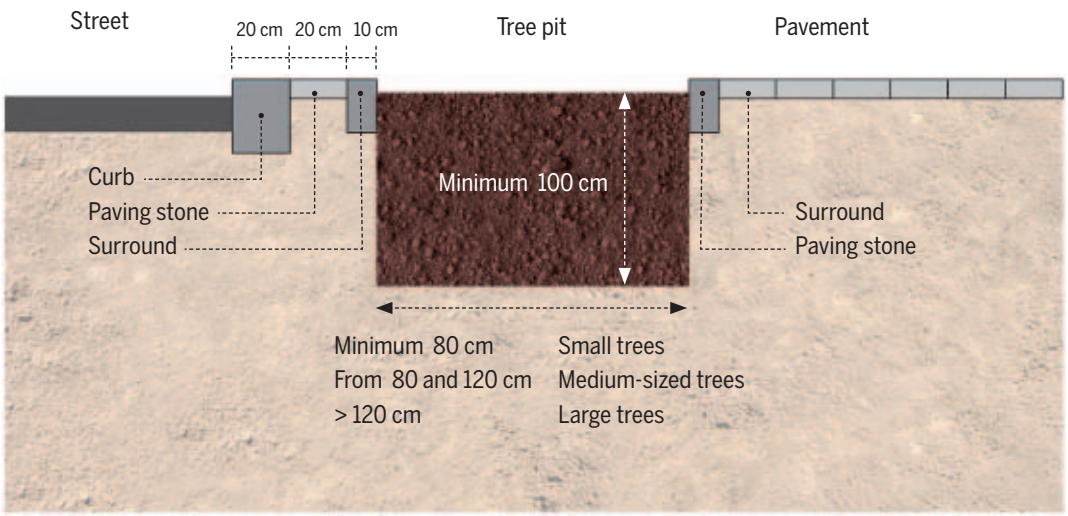
For circular tree pits the minimum diameter should be 1.2 m.

In all cases tree-pit surrounds must never jut above the level of the pavement, as this prevents rainwater from flowing into the tree pits.

In those streets where, because the pavements are not wide enough or on account of their design, tree pits have to be situated in parking spaces, the same minimum dimensions are observed, but with a surround at least 30 cms wide to create a physical barrier that prevents vehicles from driving over the tree pits. Likewise, in all those urban areas where trees are likely to be hit by vehicles (corners, dropped kerbs, parking places) it is important to ensure the protection of the trunk with strong materials capable of absorbing vehicle impact.

Expanded tree pits

Expanded tree pits are those that contain more than one tree. They can also be planted with other greenery, so forming flowerbeds on the public way. These types of tree pits are generally rectangular with a minimum width of 0.8 metres. The distance between the trunks of the trees and the building façades must be at least 3 metres.



10. The selection of trees and palm trees

The successful growth of a street tree depends largely on the quality of the sapling. So when buying, it is important to carry out a careful check. This consists of three essential points:

• Inspection of the crown (shape, state of branches, foliage).

• Inspection of the trunk (characteristics, circumference, height without branches).

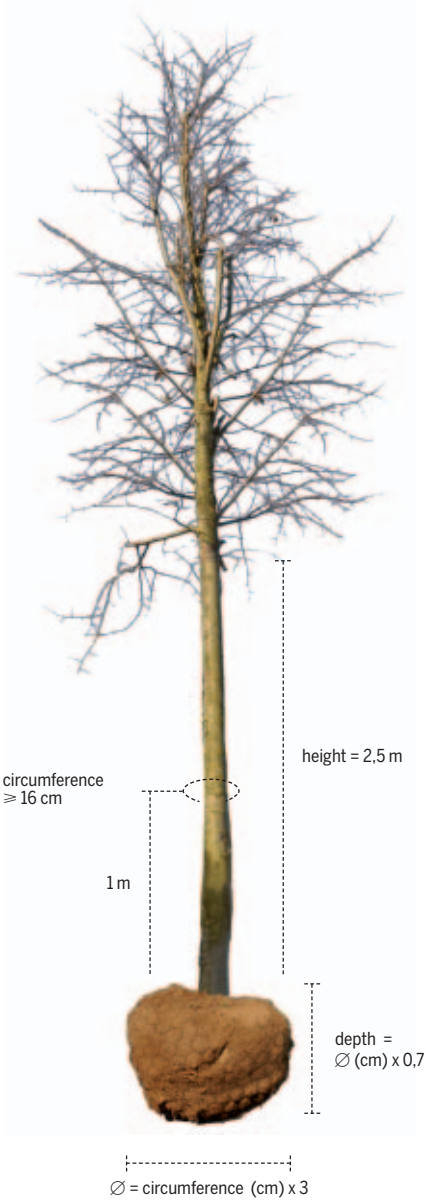
• Inspection of the root system (quantity and soundness of roots). This inspection is essential, but harder to assess, especially when the roots are wrapped up inside a plastic container or a sack.

Both the trees and palm trees supplied must comply with the current legislation on plant health, particularly with regard to pathogens that cause significant damage to the plant. In addition, palm trees and some ornamental trees such as those belonging to the Rosaceae family require a phytosanitary passport confirming they are free from certain pests and diseases, which may be bacteria, the red palm weevil, and so on.

From the time they leave the nursery to planting, saplings must be protected against structural damage, exposure to the sun, wind or extreme temperatures. Also, if planting is not immediate, they should be stored in council nurseries in a place sheltered from the sun and wind, where they remain until they are finally planted.

Trees of the same species that will be used on a particular stretch of street must come from the same batch, so that saplings planted in the same area display homogeneous characteristics with regard to trunk diameter, total height, height of the crown and its volume and shape.

Root-balled London planes (*Platanus x acerifolia*)



Healthy trees

Part above ground

• The trunk should be proportionate to the total height. It depends on the species and variety.
• The main trunk of trees with a conical crown should be intact.
• The crown should be proportional to the girth of the trunk and present a minimum of three well-balanced boughs.
• The tree should have a single trunk, straight and vertical, undamaged and free of deformities.
• The trunk must be free of branches to a height of at least 2.5 m
• Leaves must be in good health, free of pests and diseases, chlorosis or necrosis.
• The trunk is measured one metre above the ground line.
• In the case of street trees the circumference of the trunk at the time of planting must be greater than sixteen centimetres. Trunk sizes (perimeter in cm) are classified as follow: 16-18, 18-20, 20-25 (the most common in the city), 25-30, 30-35 and 35-40 (special trees).

Part below ground

• Trees should be supplied root-balled or in a container. Bare-root trees are not accepted.
• The tree should have been root pruned at least twice. The roots must have numerous absorbent hairs.
• The root ball must be solid, compact and without cracks, with a properly developed secondary root system.
• The minimum and maximum dimensions, both for root balls and containers, respect the following guidelines:
Diameter = Average of the trunk circumference (in cm) x 3
Depth = diameter of the root ball (in cm) x 0.7

Healthy palm trees

Part above ground

• The trunk should be straight and vertical, free of scratches or wounds, or any sign of strangulation.
• Petticoat and fan palms should be transplanted after root pruning following at least 2 to 3 months of biological activity. In the case of the Canary Island date palm (*Phoenix canariensis*), this time should be extended to at least 4 to 6 months.
• The distance between the trunk and the outside of the root ball must be at least 20 cm, except in the case of *Phoenix canariensis*, where it should be 30 cm.

Part below ground

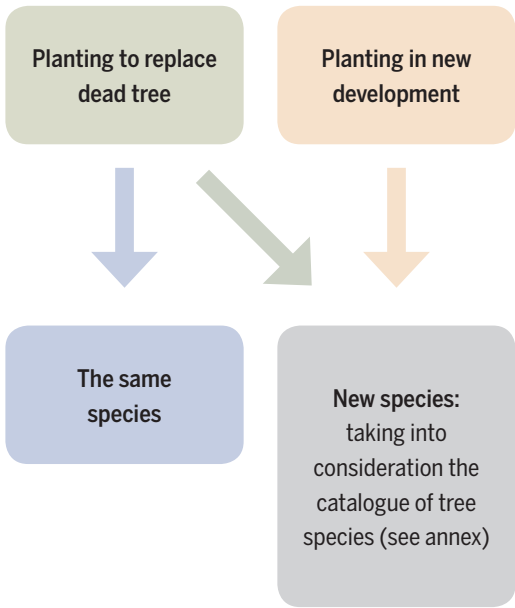
• Palm trees are supplied root-balled or in a container.
• The depth of the root ball or container must be at least equal to its diameter.
• In all cases, the roots should be well trimmed, cleanly cut without tears.
• The root ball must be kept compacted to ensure the consistency of the root system. It can be held in place by biodegradable materials or others that are removed when planting.
• Palm trees supplied in containers should have been transplanted to the container and left to grow new roots there at least a year before, so that the mass of roots holds its shape when removed from the container.

11. Deciding when to plant

In Barcelona, the decision to plant mainly depends on two conditions:

Planting in new developments: when a street has been remodelled or in new urban developments (the case of the 22@ district, for example).

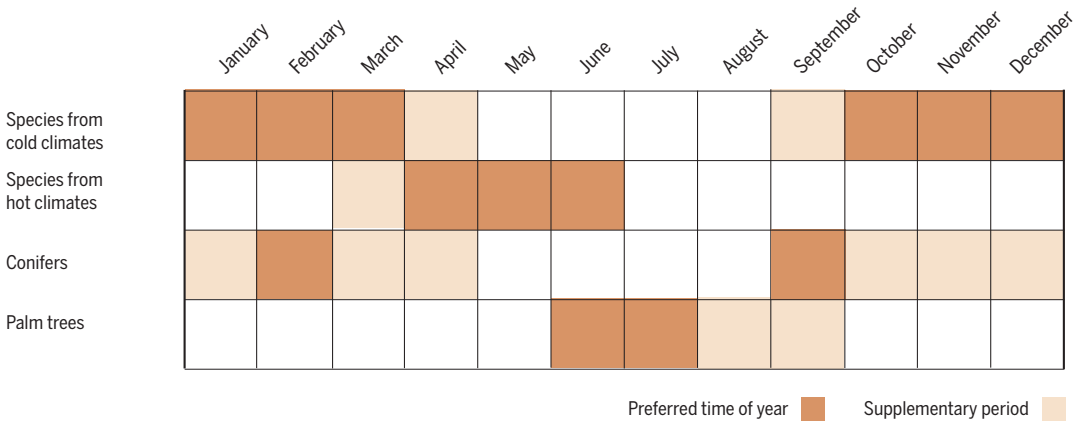
Planting to replace dead trees: when a dead tree is removed from a tree pit, it is replaced by a new tree, which may or may not be of the same species.



In general, the planting of root-balled trees should be done during the dormant season, which for species from cold and temperate zones usually lasts from November to April (in any case, avoiding frosty days or other unfavourable weather conditions). As regards species from warmer climates the April-June period is preferable. In Barcelona, with its dry summers and mild winters, planting in autumn has some advantages, because when summer comes round the trees already have new roots and cope better in these hotter months. In the case of conifers, however, it is better to plant them when they begin new growth. Palm trees are another exception, as they must be planted in the hot season when they are active.

On the other hand, when trees are delivered in containers they can be planted at any time of the year.

Favourable periods for planting in Barcelona



12. Planting work

Planting a tree is always a delicate operation because to a large extent the survival and later growth of the tree depends on it. When planting in streets, the work schedule should be planned properly, as regards both digging the hole and the supply of materials: soil and trees. The work should also be appropriately signed and cordoned off, as it often obstructs the public way.

The planting process step by step

The different operations involved in planting a tree in the urban environment should be carried out in the following order:

1. Dig the hole in the tree pit the day before planting to allow aeration.

2. Change all the soil in the tree pit, or at least remove all the existing soil to a minimum depth of one metre.

3. Remove the tree from its container – if so supplied – without damaging the root ball. Cut away wire mesh and the reinforced plaster cast from the top and bottom, if the root ball is protected in this way. There is no need to remove biodegradable wrapping, which breaks down within a year and a half and does not affect subsequent growth of the tree or its root system.

4. Place the tree at the bottom of the hole, on a layer of high quality soil, making sure the root ball is sitting at the proper height.

5. Straighten the tree into its natural position, making sure the root ball is well stabilised.

6. Put staking close to the tree, at a minimum distance of 20 cm, taking care not to damage the roots.

7. Gently fill in the hole.

8. Pack the soil down firmly as the hole fills up. This prevents the formation of air pockets and helps the tree to settle in the tree pit.

Planting a tree in a tree pit

9. Fill the hole to a depth of 15 cm below the level of the pavement, so that as much water as possible is collected when it rains or when the tree is watered, without exposing the roots. If drip irrigation is installed, the tree pit can almost be filled up with soil to pavement level, though always leaving a minimum depth of 5 cm.

10. Whatever the planting conditions, the tree must always be watered within 24 hours at the most to make the soil settle in the hole and compact it around the roots, thus eliminating air pockets and reducing transplant shock. Even if a drip irrigation system has been installed in the tree pit, the first time the tree is watered must always be with a hosepipe

Staking

The purpose of staking is to anchor trees, to keep them upright, protect them from blows and prevent high winds from loosening the roots. Therefore, stakes should be made of strong, durable materials such as treated wood. The total length should be at least 2 metres, of which about a quarter is sunk into the ground. They are used for four years following planting, after which they are removed. The number of stakes depends on the size of the tree: two for trees with a trunk circumference up to 30 cm and four for larger ones. The stakes should be joined together by pieces of treated wood.

Composition and characteristics of backfill

The composition and characteristics of the backfill used when planting street trees in Barcelona is as follows:
– Sand: 40% (by volume, varying grain size)
– Topsoil: 20% (by volume)
– Coconut fibre: 30% (by volume)
– Clay: 10% (by volume)

Some other materials are added:
– Colloidal silica, which makes irrigation more effective and facilitates the storage of nutrients
– Slow-release fertilizer
– Hydrogel, which helps keep the soil moist in tree pits

Physicochemical characteristics:
– PH between 6 and 8
– Electrical conductivity lower than 3 dS/m
– Disinfected – free from pathogens and seeds

Backfill for planting: sand, topsoil and soil conditioner

The ties holding the tree trunk to the stakes should be made of a flexible material (for example, rubber) which is long-lasting and weather-resistant. In addition, they must be firmly attached to the stake, wide enough to avoid injury to the trunk and neither too tight (strangling the tree trunk) nor too loose (not doing their job).

It is important to check the staking from time to time to make sure it is still holding the tree straight and, if necessary, reposition the tree, the stakes and the backfill in the tree pit, because sometimes trees are dislodged after planting.

Covers for tree pits

Ideally, tree pits should be left uncovered because this allows for greater oxygenation and better filtration of rainwater. However, they can become architectural barriers for pedestrians on narrower pavements. When this happens, tree pits should be covered over so that they do not obstruct pedestrian traffic.

Covering systems must guarantee the entry of as much water as possible and also soil aeration, and allow for thickening of the tree trunk as it grows, without damage to either the tree or the cover itself. In addition, they must be easy to remove in order to facilitate cleaning and inspection, and repairs to the irrigation system if need be.

Staked trees in Passeig de Gràcia

Covers for tree pits

Open tree pits
This is the cheapest option and the best for the trees. However, proper maintenance is necessary (regular cleaning and weeding). They constitute an architectural barrier, especially on narrow pavements.

Tree pits with a grating
Gratings are usually made of steel or cast iron, very durable and with holes larger than 2 cm. They look better and are more pedestrian-friendly, being placed at pavement level and thus allowing unobstructed passage for everyone.

Tree pits covered with porous materials
The entire tree pit is covered over with resin-bound or similar materials, thereby ensuring unhindered passage of pedestrians. There is less maintenance, because weeding and periodic cleaning are not necessary, but rainwater and irrigated water are slow to filter and they do not allow good soil aeration either.

13. Irrigation

In Barcelona, trees are watered weekly during the first year after planting, with water from the subsoil. In the second year and for three years, they are watered once a week in summer, fortnightly in spring and autumn and once a month in winter. In all cases, irrigation should be abundant so that the water soaks deeply into the soil.

The stakes in the tree pits serve as guide to watering. Every year they are painted a different colour in the order yellow, white, green and blue, to indicate how many years the trees have been planted and how often they need watering, because it is extremely important to ensure suitable irrigation depending on location, age and species.

When planting in new developments automatic drip irrigation systems are always installed. Their many advantages include:

- Savings in water consumption and more efficient use, thereby saving on energy and labour.
- Programmed for better irrigation management.
- Less water wasted though runoff.

Watering trees from a tanker

14. How is pruning carried out?

Pruning is necessary in urban areas to adapt the tree to the local conditions and for reasons of public safety.

In recent years, pruning guidelines and trends focus on letting trees grow freely and pruning them only when strictly necessary (shaping, cleaning and safety).

Before pruning, the following points should be considered:

- The characteristics of the species: size, flowering time
- The growth stage of the tree
- The time of year
- The structure and general condition of each tree

On the other hand, many trees planted a long time ago also need restructuring, mainly because the wrong species was chosen and due to environmental pressure.

Every year, trees in 25% of the streets in each district are pruned (following a set order), while additional pruning is carried out depending on the needs that arise during the year or identified in the annual inspection.

The plan is to rotate the pruning of all street trees in the city every four years, using the appropriate approach for each species. In the case of palm trees rotation is completed every two years, and also for Seville orange (*Citrus aurantium*), owing to pests, while in the case of fruiting mulberry (*Morus alba and Morus nigra*) and grey poplars (*Populus canadensis*) annual pruning is carried out to prevent fruiting and the ensuing inconvenience.

Pruning is grouped into different categories depending on the growth stage of the tree, the type of pruning, and when it is carried out: shaping, maintenance, restructuring, and pruning of palm trees.

Pruning from a platform with a chainsaw

Pruning with long-reach pruners

Type of pruning	Growth stage	Purpose of pruning	Time of pruning
Shaping	For 3 years after planting	Lifting and narrowing of crown Cleaning	All year (preferably in the dormant season)
Maintenance	After 4 years	Cleaning and care Thinning Safety	
Restructuring	Adult trees	Reduction and reshaping of crown	
Palm trees	For 2 years after planting	Cleaning and care Safety	All year except during the hottest months to avoid palm weevil infestation

Shaping: the goal is to shape the tree after planting to favour proper growth.

Maintenance: pruning to keep street trees healthy.

Restructuring: involves a reduction in the size of the crown when branches are diseased or damaged or when they are lopsided or misshapen.

Pruning of palm trees: this is a special maintenance technique limited to removing dry fronds, suckers, inflorescences and fruits, while respecting the natural spherical shape of the crown.

Pruning waste is removed while work is in progress. Once the solidest part has been separated out, the remainder is shredded to make compost for new backfill. And in the near future a new biomass plant will convert green waste from urban parks and gardens into a renewable energy source.

When it is necessary to remove a dead street tree or one in bad condition, the pruning brigade removes the branches and trunk and then extracts the stump and roots using the appropriate machinery.

15. Tree health

Trees are living organisms subject to constant pressure, particularly in urban areas. During the different stages of their life cycles they have to deal with numerous attacks, some more serious than others. Their intensity and duration inevitably affects the health of the tree.

Trees are sometimes affected by physiological changes (caused by the weather, nutritional deficiencies, poisoning, burns, physical injuries) or may be attacked directly by pests and diseases (viruses, bacteria, fungi, nematodes, insects, mites, etc.).

Sometimes an external injury or a situation of stress leaves the tree vulnerable to the entry and spread of pests and diseases, particularly insects, mites and fungal infections. These attacks can have diverse consequences: they may simply affect the aesthetic appearance of the tree, they may weaken the tree and slow down growth, or, at worst, they may kill a part of or the whole specimen. The trees' response to these attacks is betrayed by their external appearance.

Traditionally, pests and diseases affecting urban greenery were treated with chemicals in the same way as crops. However, Barcelona City Council's commitment to sustainability, together with increasingly restrictive European and Spanish legislation, has led to the increased use of integrated pest control methods.

Integrated pest management (IPM) is the integration of various types of control in a common strategy, considering not only economic criteria but also ecological and toxicological ones. IPM makes use of conventional chemicals, biological insecticides, biological control using natural predators and parasitoids, biotech techniques (using pheromones, repellents and inhibitors), and also genetic control through the selection of resistant varieties and application of cultural practices. IPM rejects the principle of eradication of populations and tolerates the presence of insects, mites and other pathogens at a low level, while they do not reach a level (the economic threshold) where there is the threat of financial loss.

Thus, IPM meets three goals simultaneously:

- It favours the introduction of control techniques that may be less efficient but are cleaner (mechanical control, tolerant and resistant varieties, biological control).

The fight against the red palm weevil, an example of mechanical control

The red palm weevil (*Rhynchophorus ferrugineus*), which mainly attacks the Canary Island date palm (*Phoenix canariensis*) and the date palm (*Phoenix dactylifera*), was identified for the first time in Barcelona in December 2006. In this city, the weevil attacks the Canary palms, causing severe damage that often leads to the death of the tree. Thanks to special pruning of trees infested by the weevil – pruning of the whole crown and destruction of all the fronds – infested specimens have recovered well, thus avoiding the need to cut them down.

• It reduces the need for phytosanitary treatments with conventional pesticides containing toxic products that damage the ecosystem, which are harmful to autochthonous insects and other native species such as birds and small mammals, vital for maintaining the balance of the ecosystem.

• It allows for the use of natural predators and parasitoids.

Periodic inspection of trees

Sometimes accidents caused by broken and falling branches are unavoidable, as they happen for no apparent reason or are caused by factors such as storms with heavy rain and high winds. In other cases, the poor condition of the tree is more obvious and it can be inspected to assess and avoid the risk of falling and broken branches.

Accordingly, a visual check of trees and palm trees in streets is performed at least once every two years so as to verify their structural condition and vitality, detect situations of foreseeable risk and take appropriate steps.

This inspection is based on two procedures:

• A visual examination is carried out to check the particulars of the tree (species, category, height and girth), its external appearance (vitality, leaning, presence of injuries, canker, cavities) and general state of health (normal, altered, decaying or dead).

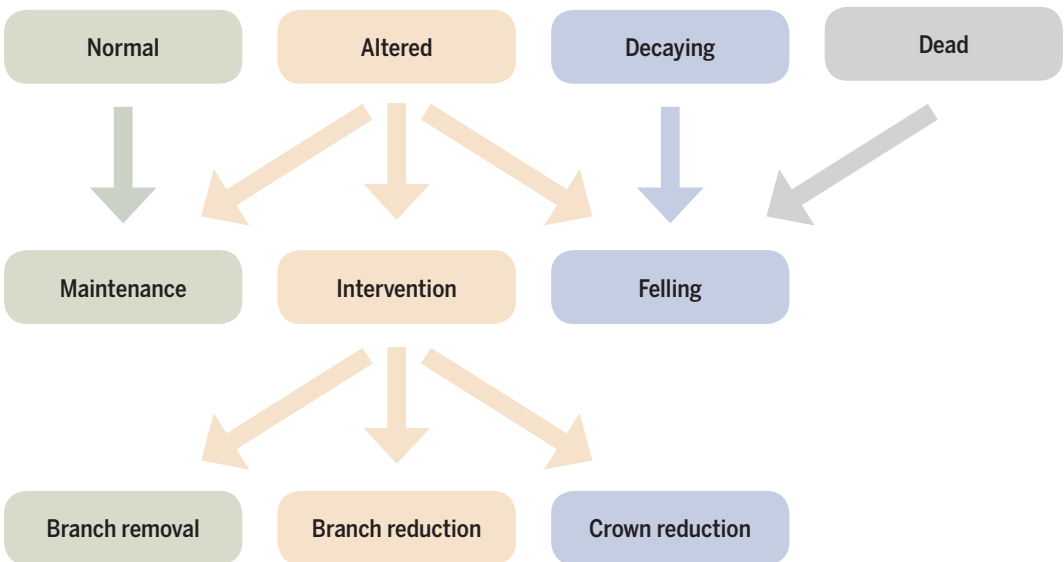
• Depending on the results of the study, measures are taken that may involve:

Maintenance: all those specimens in good condition receive routine maintainence.

Intervention: this may include the removal of branches or reduction of the crown. In the case of palm trees, fronds in poor condition are removed.

Felling: trees that run the risk of falling down and/or have no viable future are cut down.

The following scheme shows the measures carried out depending on the state of the tree. As regards palm trees, the procedure is the same, except that the measures taken consist of removing fronds or felling and this is done at the time of inspection.



The most common pests and diseases in the city

Aphids, scale insects, processionary caterpillars and canker are the pests and diseases that most commonly affect trees in the city. As regards canker, it is caused by a fungus in conjunction with an insect. It causes a conspicuous and typical wound in the bark of plane trees. On the other hand, with the coming of summer the sudden loss of leaves in some species is not unusual, mainly from plane and lime trees due to water stress.

When an attack occurs, the severity of damage depends on the type of parasite, the duration of the attack, the time of the year when it takes place, the state of the plant and the affected part. In addition, there is an impact on all the social and environmental aspects of greenery, i.e. aesthetics, landscaping, health, safety and heritage.

Measures taken to combat pests and diseases

Each year in Barcelona, depending on the plant species attacked and the pest or disease in question, a control programme is prepared, which includes monitoring of stretches of affected streets.

Treatments are as follows:

Preventive treatments, which focus on controlling harmful organisms. These are carried out when populations reach epidemic levels.

Curative treatments, which are used when pests or disease already exists.

Both types of treatments use the following methods:

Applications of organic products, where natural chemicals (from plants, minerals, etc.) are used. This is the case, for example, of the piretrines, vegetable oils, the azadirachtins and potassium soaps, made using Piretrum sp., anthra-

Name of pest or disease	Tree species most affected in Barcelona
Plane lace bug (*Corythuca ciliata*)	London plane (*Platanus x acerifolia*)
Powdery mildew (*Microsphaera platani*)	
Pine processionary caterpillar (*Thaumetopoea pityocampa*)	Aleppo pine (*Pinus halepensis*)
	Stone pine (*Pinus pinea*)
Elm leaf beetle (*Xanthogaleruca luteola*)	Elm (*Ulmus sp.*)
Judas tree psyllid (*Cacopsylla pulchella*)	Judas tree (*Cercis siliquastrum*)
Red palm weevil (*Rhynchophorus ferrugineus*)	Canary palm (*Phoenix canariensis*)
Woolly whitefly (*Alleurothrixus floccosus*)	Seville orange (*Citrus aurantium*) and other citric trees (*Citrus sp.*)
Citrus Mealybug (*Pseudococcus citri*)	
Kermes scale insect (*Kermococcus vermilio*)	Holm oak, oak (*Quercus sp.*)
Dutch elm disease (*Ceratocystis ulmi*)	Elm (*Ulmus sp.*)
Several species of aphids	Various (tilo, robinias, chopos, etc.)
Cypress canker (*Seiridium cardinale*)	Mediterranean cypress (*Cupressus sempervirens*)
Dieback fungus (*Diplodia mutila*)	Holm oak (*Quercus ilex*)

Source: compiled by the authors

Stress in plane trees

One of the most typical features of the Mediterranean climate is that during the summer dry season the intense sunlight and high temperatures cause high rates of evapotranspiration and water loss from leaves. At this time of the year, rain falls sporadically, if at all, generally coming in heavy showers.

Street trees are directly affected by these adverse weather conditions, which are accentuated by the even higher temperatures generated by the structure of the city itself, with buildings that reflect sunlight and do not dissipate energy due to the lack of evaporative surfaces, therefore further heating up the atmosphere. In addition, the effect of air pollutants must also be taken into account, emitted by urban activity, mainly vehicle traffic. And to make matters worse, trees have a much smaller water reserve because the ground is impermeable (tarmac, pavements, services).

These environmental conditions, which are far from ideal for trees to grow in, lead to "water and heat stress", which is manifested to a certain extent by partial defoliation well before autumn. Leaf loss is a defence mechanism that reduces water loss and thereby prevents dehydration.

Windy days favour the massive fall of weakened leaves. This does not signal the coming of autumn, but rather it is quite simply how trees defend themselves in the city. In Barcelona, this phenomenon particularly affects plane trees.

cite oils and coal, the Azadirachta Indica tree and natural vegetable oils, respectively.

Use of biological control organisms or useful fauna introduced artificially. This consists of fighting pests through the introduction of other species of insects that are their natural enemies and reduce the numbers of the pest population. There are basically two types: predators (feeding on more than one host) and parasitoids (only needing one host to fully develop).

The use of trunk injections, in which the product is injected directly into the vessels where the sap of the affected plant circulates. This method entails direct application to the trunk, which ensures the full dose reaches the tree and reduces the possibility of contamination or accidental spillage.

With the passing of new laws placing tighter restrictions on the use of chemicals and the growing amount of information garnered from research in this field, the application of preventive treatments is taking increasing precedence, as these are more efficient and environmentally-friendly.

16. Health and safety at work

In the city, the situations created by maintenance work can be complicated, with the obstruction of streets and pavements. Accordingly, vehicle traffic, pedestrians, services, homes and workers must be given due consideration and maximum safety precautions and special measures should be taken when planting and pruning street trees:

• The public must be informed of the dates and stretch of street affected by work at least twelve days before by means of signage tied to the trees with string (to avoid damage to the trunk) at a height of two metres to make reading easier.

• The affected area must be cordoned off with barrier tape to prevent pedestrians using the pavement while nearby street trees are undergoing maintenance.

The Municipal Institute of Parks and Gardens health and safety policy is based on the provisions stipulated in Article 15 of Law 31/1995 covering risk prevention. Moreover it has received OHSAS management system certification.

The health and safety standards that generally govern pruning work are as follows: specialised theoretical and practical training for personnel carrying out this work; the provision of specific personal protective equipment (PPE); periodic inspection of equipment and tools used, and a special medical check-up for personnel doing this work. Other regulated work include the use of platform lifts, needed when it is not possible to use cherry-pickers – owing to steep gradients or inaccessibility; the use of telescopic tools from the ground, and lastly, the use of climbing techniques, necessary when none of the above techniques is feasible.

In view of its importance the use of PPE (personal protective equipment) is mandatory.

17. Protecting trees

All urban trees are living organisms that contribute to the environmental balance of the city and deserve maximum respect. The City of Barcelona is committed to the defence and conservation of the public green heritage and to guaranteeing the protection of all the city's trees.

How to protect trees during work on the public way is explained in a list of recommendations and through the application of the **Granada Regulations**, while unique specimens are protected by the **Catalogue of Trees of Local Interest**.

Protection of trees during building work

Irreversible damage is often inadvertently caused to trees during building work. The digging of trenches, soil compaction, soil sealing and a drop in the water table are hazards that must be taken into account when working around trees.

Many building projects, and the installation or repair of utility services, often involve the movement or parking of all types of materials, lorries, cranes and other machinery that may be a hazard to trees. Before carrying out any project, it becomes imperative to draw up a plan of action that guarantees the protection of all trees, including those that do not initially appear to be affected by the work. This plan establishes the access routes and parking areas for the different machinery (cranes, excavators, lorries) and clearly defines the parking and storage areas, respecting the safety margin around the trees as much as possible.

In the case of trees to be transplanted,

Protection for the bark of trees

Transplanting a nettle tree (*Celtis australis*)

Recommendations for protecting trees during work

1. It is important not to compact the ground around trees.

2. Given the inability to prevent vehicle access and accumulation of materials, the ground around the tree should be covered with a layer of drainage material (gravel) at least 20 centimetres thick, which will be covered by boards or some similar material.

3. Avoid open trenching within 1 metre of tree pits.

4. When trenching within 1 meter of the trunk is unavoidable, it must be done manually, and if roots have to be cut away this operation should be supervised by specialists from the city council.

5. To counter possible root reduction, corrective pruning of the crown of the tree should be given consideration, or in the case of palm trees the fronds should be tied before work starts.

6. In streets, to avoid physical damage, trees must be surrounded by a wooden barrier at least 2 metres tall or ringed by tyres.

7. In open spaces, to avoid physical damage, a wooden barrier or wire netting 1, 2 to 1.8 meters high should be placed around the trunk at a distance of 2 metres (5 metres in columnar trees).

8. Material must never be left in tree pits or site offices situated over them.

9. Rubble and toxic waste must not be left near trees.

10. Trees cannot be used as supports for fencing, signs and electrical installations or similar, except for the signage referring to work on the trees themselves.

Barcelona City Council makes a mandatory report as stipulated by the **Granada Regulations** and demands a deposit to cover the possible cost of replacing greenery, in accordance with the valuation established by the aforementioned regulations.

The method of valuation established by the Granada Regulations, promoted by the Spanish Association of Public Parks and Gardens and published in 1990, was approved by Barcelona City Council at a meeting held on 22 April 1993. It has been updated several times since then and the City Council has developed software to streamline the administrative procedures.

Catalogue of Trees of Local Interest

The Catalogue of Trees of Local Interest lists most the valuable trees in Barcelona's city streets and private gardens as considered from an ecological and historical standpoint. These trees, owing to their size, age, unusualness, aesthetic or historical importance, botanical rarity or interest, are given special protection to guarantee their conservation.

Trees, thanks to their longevity, are often the only living testament to the history of neighbourhoods and cities. The inclusion of a tree or group of trees in

the Catalogue provides for their conservation, whether they are growing on public or private property, since in no case can trees or groups of trees included in the catalogue be removed or altered.

The decision to include a tree in the catalogue is based on the assessment guidelines drawn up by a committee of experts in agronomy, biology and heritage, which examines those specimens that may merit special conservation measures.

Given the public interest in protecting trees of local interest, in 2008 organizations, institutions, professionals and other members of the public linked to the academic, technical and professional side of gardening and urban design were invited to join the committee.

Trees are proposed for listing in the catalogue for many reasons. When trees are in private ownership, the application must be made by the owner or the City Council itself on detecting the tree's special character. All proposals are studied to assess their suitability. Once the proposal is approved, a file on the tree (or group of trees) is opened. The tree is assigned a catalogue number and the details of its height, girth and diameter of the crown, estimated age, location, reasons for listing, a photo and a map showing its location are registered. Each catalogued tree is identified by a nameplate so that it can be easily located.

From then on, the City Council is responsible for looking after the tree, whether it is on public or private property. It also takes care of the surroundings of the tree.

The catalogue is available at:
www.bcn.cat/mediambient

18. Data management

A constantly updated inventory containing the characteristics of the trees and the most useful data for maintenance work is basic to good tree heritage management. In 2008, Barcelona City Council introduced a street tree management programme (from here on referred to by its Catalan acronym GAVI) to meet the new needs of street tree management in the city.

The GAVI software serves to keep an inventory of the street trees in Barcelona and situates them on the city plan, while providing a management system that allows work scheduling and automatic update of data.

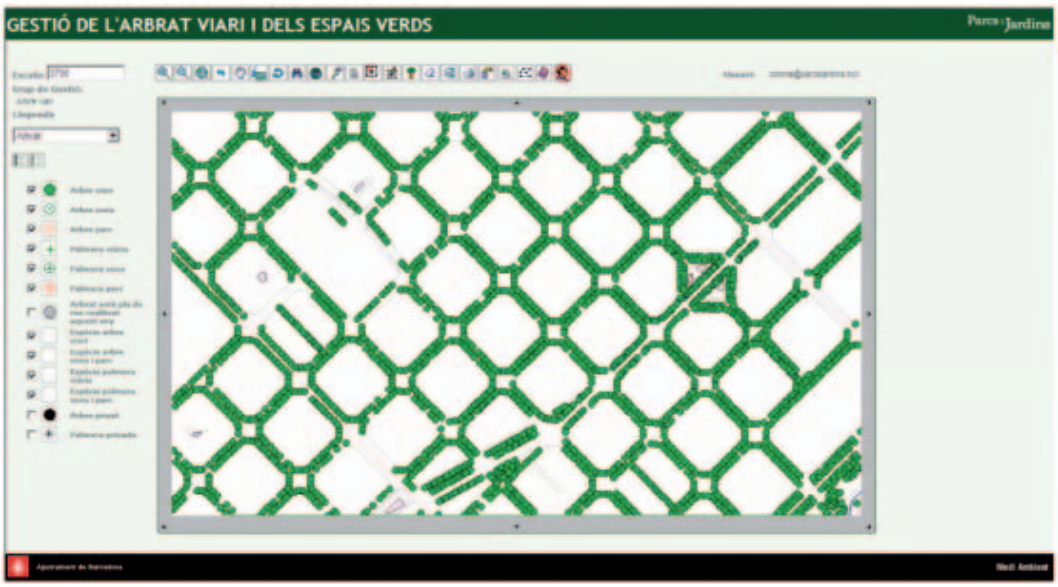
The data for each tree is stored in an individual file. This includes:

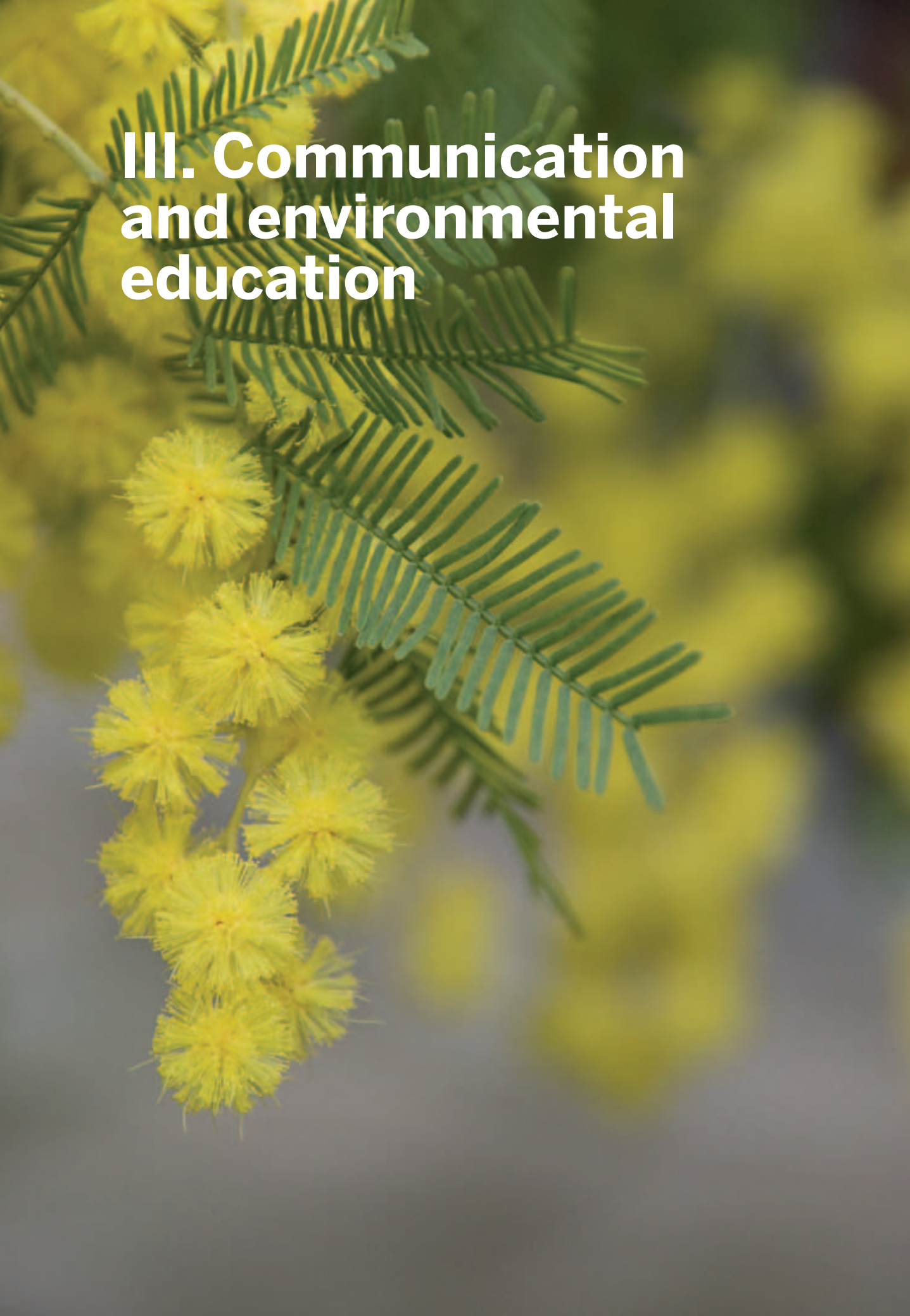
- Name of the species
- Size of the tree (trunk and height category)
- Condition and vitality of the tree
- Characteristics of its position (type of support, shape and size of tree pit, date of planting, width of pavement)
- Useful details for management (surroundings – street, open area or park, method of irrigation, presence of staking and name plate)
- Information about the tree's exact location and the personnel responsible for the tree (street, neighbourhood, district, brigade and person in charge)

This software allows technicians to view and manage the inventory online. It can be accessed through a PC or a personal organizer (PDA) and the available features are as follows:

- Access to map to manage elements visually.
- Access to data sheets of inventoried items.
- Access to information from different catalogues.
- Ability to plan jobs and tasks, request action on an item and assign work.
- Ability to see alerts and work requests, manage resources and generate reports.

Screenshot of the GAVI software





III. Communication and environmental education

19. Learning about the trees in the city

Trees are probably the type of greenery that makes its presence most felt in the lives of the people of Barcelona. Not for nothing, they grow all over the city and their presence gives public spaces touches of seasonal colour and rhythm. Therefore, it is not surprising that when the sudden arrival of hot weather results in a panorama more in keeping with autumn than summer, due to water stress, the number of enquiries and calls from citizens concerned about this situation escalates. Every year, about 5,000 people send in suggestions, complaints and warnings about street trees, especially with regard to pruning. This constitutes 75% of the total of communications received in relation to all the greenery in the city.

Looking after the trees in the street is a joint responsibility shared by government and citizens. The former has the obligation to make sure trees grow in the best possible living conditions, so that they can provide more and better environmental and social benefits, and it is also responsible for the maintenance and replacement policies that ensure the viability of this heritage. On the other hand, this work also requires public participation and awareness of the valuable role that trees play in everyone's lives. The trees we plant today will make the city more liveable tomorrow and so activities designed to disseminate knowledge about trees and their role in public life should be given priority.

A permanent communications campaign is therefore needed to inform about everyday practice and help build up participation in protecting greenery, valuing the nature of urban gardening and criteria applied to it. By means of specialised publications, brochures, campaigns and media presence, the problems, needs, services and management of street trees – one of the city's most ubiquitous features – can be given the publicity they need.

In fact, informing and educating the public in the need to value and respect street trees, through specialised educational programmes and resources aimed at specific target groups, has always been one of Barcelona City Council's priorities. In 2002, the city council signed a public commitment to sustainability, the local Agenda 21, which includes ten points directly linked to urban green spaces and their management, and where the need for street trees is given primary importance.

Barcelona City Council has organised numerous communication and dissemination activities over the years with street trees in the limelight. Particular mention should be made of those educational activities and resources intended for the teaching community, the workshops and congresses organised for more specialised groups, and the communication campaigns addressed to the general public.

Educational activities and resources

Arbres de Barcelona (Trees of Barcelona). Album of collectionable picture cards published in 1983, with photos and descriptions of sixty species of trees in the most important streets of the city.

Una llavor, un arbre (One seed, one tree). Case containing seeds of various species of street trees and a brief explanation of these.

Mimosa (*Acacia dealbata*)

Educational activities aimed at schools and designed for different levels (pre-school, primary and secondary): "Sóc un arbre" (I'm a tree), "El joc de les conifers" (The conifer game), "Juga amb el teu arbre" (Play with a tree).

Congresses and workshops

Aimed at a more specialised public, various congresses dealing directly with trees have been organised in Barcelona, such as "L'arbre a la ciutat" (Trees in the City) in 1995 and the National Arboriculture Congress (2005), as well as the workshops "El verd de l'Eixample a debat: protecció + imaginació" (The greenery in the Eixample in debate: protection + imagination), "La poda de l'arbrat" (Tree pruning) and "Manteniment i conservació de palmers" (Maintenance and conservation of palm trees) held in 1998, 2004 and 2006 respectively.

Publications

The editing and publication of brochures, guides and other material dealing with the trees of Barcelona is a necessary instrument for promoting and raising public awareness of street trees. These publications include the following:

Som joves i hem de créixer (1983) (We are young and we have to grow): brochure which explains the difficulties faced by trees on growing in an urban habitat and which seeks community participation.

Els arbres de Barcelona (1999) (The trees of Barcelona): a guide that divides Barcelona's trees into different groups: the most common, the Mediterranean species, the best integrated into life in Barcelona, the exotic species – from the standpoint of the general public – or simply the most unusual ones, with a fact file accompanying the description of each species.

Ciudadanos árboles (2003) (Citizen trees): edited in conjunction with the newspaper La Vanguardia, it contains descriptions of the commonest species in Barcelona.

Els arbres dels carrers de Barcelona/ **Los árboles de las calles de Barcelona** (2007)(The street trees of Barcelona): edited in conjunction with the University of Barcelona (UB), this guide serves to

identify the different species planted in the city streets and aims to foster admiration and protection for these life forms that keep us company and improve our quality of life.

Lastly, the review *Barcelona Verda* (1992-2009), (Green Barcelona), published every two months and with over 10,000 readers, reported on the maintenance and management of street trees carried out by Barcelona City Council.

Communication campaigns

In order to involve the public in the conservation of this valuable natural heritage, educational campaigns are a constant in city council communication policies. These include::

Els arbres tenen nom. (The trees have names). To inform the public about the trees in Barcelona, the campaign "The trees have names" was launched in 1999, which consisted of identifying street trees with nameplates indicating their popular and scientific names and geographical origin. In total, over 3,000 nameplates were installed in all neighbourhoods and today these signs form part of the cityscape. The campaign began initially with a competition organised by the FAD (Promotion of Decorative Arts) for a nameplate design.

Los árboles de la memoria (Commemorative trees). The "commemorative trees" are a community initiative, the result of events organised by community associations and entities to mark important historical events, to honour people or organisations of general interest, by planting a tree with a commemorative plaque. In Barcelona there are currently 36 commemorative trees or groups of trees. These are listed in a special catalogue.

Tree nameplate

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The street trees of Barcelona

A list of tree and palm tree species currently growing on the streets of the city is presented on continuation. The table lists the Latin nomenclature, the common name in Catalan, Spanish and English, the size of the tree, its preferred placement (street, open area or park), the permanence of the leaves (evergreen or deciduous) and its suitability in Barcelona as a street tree planted in tree pits. This latter information is fruit of the experience gained over many years by the specialists at the Municipal Institute of Parks and Gardens.

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Acacia dealbata	Mimosa comuna	Silver wattle	O/P	M	IR	E		Problems taking root. Branches break easily
Acacia retinodes	Mimosa de tot l'any	Swamp wattle	O/P	S	IR	E		
Acacia saligna (A. cyanophylla)	Mimosa blava	Coojong	S-O/P	S	IR	E		Branches break easily. Invasive
Acer buergerianum	Auró tridentat	Trident maple	S-O/P	S		D		
Acer campestre	Auró blanc	Field maple	S-O/P	M		D		
Acer monspessulanum	Auró negre	Montpellier maple	S-O/P	M		D		
Acer negundo	Negundo	Box elder	O/P	M	IR	D		Problems taking root. Branches break easily
Acer opalus	Blada	Italian maple	S-O/P	L		D		
Acer platanoides	Erable	Norwegian maple	S-O/P	L		D		Difficulty adapting
Acer pseudoplatanus	Plàtan fals	Sycamore	S-O/P	L		D		Difficulty adapting
Acer saccharinum	Auró argentat	Silver maple	S-O/P	L		D		Difficulty adapting
Acer x freemanii 'Autum blaze'	Auró de Freeman	Freeman maple	S-O/P	M	IR	D		
Aesculus hippocastanum	Castanyer d'Índia	Horse chestnut	S-O/P	L		D		Difficulty adapting
Ailanthus altissima	Ailant	Tree of heaven	O/P	L		D		Invasive
Albizia julibrissin	Acàcia taperera	Pink siris	S-O/P	M	IR	D		
Albizia julibrissin 'Ombrella'	Acàcia taperera	Pink siris	S-O/P	M	IR	D		
Alnus cordata	Vern italià	Italian alder	S-O/P	L		D		Difficulty adapting
Alnus glutinosa	Vern	Common Alder	S-O/P	L		D		Difficulty adapting
Archontophoenix cunninghamiana	Palmera de Cunningham	Bangalow palm	S-O/P	M		E		

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Bauhinia forficata	Pota de vaca	Pata de vaca	S-O/P	M	IR	D		
Bauhinia candicans	Pota de vaca	Pata de vaca	S-O/P	M	IR	D		
Bauhinia purpurea	Pota de vaca	Orchid tree	S-O/P	M	IR	D		
Betula pendula	Bedoll	Silver birch	S-O/P	M		D		Difficulty adapting
Brachychiton acerifolius	Arbre de foc d'Austràlia	Illawarra Flame Tree	S-O/P	M		D		
Brachychiton discolor	Braquiquiton blanc	Lacebark Tree	S-O/P	M		D		
Brachychiton populneus	Arbre ampolla	Kurrajong	S-O/P	M		E		
Broussonetia papyrifera	Morera de paper	Paper mulberry	S-O/P	L	IR	D		
Carpinus betulus	Carpí	Common hornbeam	S-O/P	L		D		Difficulty adapting
Casuarina cunninghamiana	Casuarina comuna	River oak	S-O/P	L	IR	E		
Catalpa bignonioides	Catalpa comuna	Indian bean tree	S-O/P	L	IR	D		
Catalpa bungei	Catalpa de Bunge	Manchurian Catalpa	S-O/P	M		D		
Celtis australis	Lledoner	Southern nettle tree	S-O/P	L		D		Common in Barcelona. Around 15% of total
Celtis occidentalis	Lledoner americà	Hackberry	S-O/P	L		D		
Cephalotaxus harringtonia	Teix d'Hokkaido	Cowtail pine	S-O/P	S		E		Difficulty adapting
Ceratonia siliqua	Garrofer	Carob	O/P	M	IR	E		Unsuitable for streets
Cercis siliquastrum	Arbre de l'amor	Judas tree	S-O/P	M		D		
Chitalpa tashkentensis	Chitalpa	Chitalpa	S-O/P	M		D		
Chorisia speciosa	Arbre de la llana	Silver floss tree	O/P	M		D		Trunk with thorns
Citrus aurantium	Taronger amarg	Seville orange	S-O/P	S		E		Very vulnerable to pests and diseases
Citrus limon	Llimoner	Lemon	S-O/P	S	IR	E		Very vulnerable to pests and diseases
Citrus reticulata	Mandariner	Mandarin	S-O/P	S	IR	E		Very vulnerable to pests and diseases
Cocculus laurifolius	Còcul	Laurel-leaved snail tree	S-O/P	M		E		

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Corylus colurna	Avellaner turc	Turkish hazel	S-O/P	M		D		
Crataegus laevigata 'Paul scarlet'	Espinalb centreuropeu	Midland hawthorn	S-O/P	S		D		
Crataegus x lavalleei 'Carrierei'	Arç de Carrière	Lavelle hawthorn	S-O/P	S		D		
Crataegus monogyna	Arç blanc	Common hawthorn	S-O/P	S		D		
x Cuprocyparis leylandii	Xiprer de Leyland	Leyland cypress	S-O/P	L		E		
Cupressus arizonica (C. glabra)	Xiprer d'Arizona	Smooth American cypress	O/P	L		E		Unsuitable for streets
Cupressus macrocarpa (C. lambertiana)	Xiprer de lambert	Monterey cypress	O/P	L	IR	E		Unsuitable for streets
Cupressus sempervirens	Xiprer	Mediterranean cypress	S-O/P	L		E		
Cupressus sempervirens 'Stricta'	Xiprer	Fastidiate Mediterranean cypress	S-O/P	M		E		
Dodonaea viscosa	Dodonea comuna	Hopbush	S-O/P	S	IR	E		
Elaeagnus angustifolia	Arbre del paradís	Oleaster	O/P	M	IR	D		Unsuitable for streets
Eriobotrya japonica	Nesprer del Japó	Loquat	O/P	S		E		Unsuitable for streets
Erythrina crista-galli	Eritrina cresta de gall	Cockspur coral tree	S-O/P	L		D		
Eucalyptus camaldulensis	Euc. de fulla estreta	Murray red gum	O/P	L	IR	E		Invasive roots
Eucalyptus globulus	Eucaliptus comú	Tasmanian blue gum	O/P	L	IR	E		Invasive roots
Ficus benghalensis	Figuera de Bengala	Banyan	O/P	L		E		Invasive roots
Ficus carica	Figuera	Fig	O/P	M	IR	D		Invasive roots
Ficus elastica	Ficus de cautxú	Evergreen fig	O/P	L		E		Invasive roots
Ficus microcarpa (F. nitida, F. retusa)	Ficus de l'Índia	Indian laurel	O/P	M		E		Invasive roots
Firmiana simplex	Firmiana	Chinese parasol tree	S-O/P	M		D		
Fraxinus americana	Freixe americà	White ash	S-O/P	L	IR	D		Difficulty adapting
Fraxinus angustifolia	Freixe de fulla petita	Narrow-leaved ash	S-O/P	L	IR	D		Difficulty adapting

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Fraxinus angustifolia 'Raywood'	Freixe de fulla petita	Narrow-leaved ash	S-O/P	M	IR	D		
Fraxinus excelsior	Freixe de fulla gran	Common ash	S-O/P	L	IR	D		Difficulty adapting
Fraxinus pensylvanica	Freixe de Pensilvània	Red ash	S-O/P	L	IR	D		
Ginkgo biloba	Ginkgo	Maidenhair tree	S-O/P	L		D		Avoid female plants, the fruit fouls pavements and smells unpleasant
Ginkgo biloba 'Fastigiata'	Ginkgo	Maidenhair tree	S-O/P	L		D		
Gleditsia triacanthos	Acàcia de tres punxes	Honey locust	S-O/P	L	IR	D		Presence of thorns. Replace with the 'inermis' thornless variety
Gleditsia triacanthos f. inermis	Acàcia negra inerme	Honey locust	S-O/P	L	IR	D		
Gleditsia triacanthos 'Skyline'		Honey locust	S-O/P	L		D		
Gleditsia triacanthos 'Sunburst'		Honey locust	S-O/P	M	IR	D		
Grevillea robusta	Grevil·lea comuna	Silk oak	S-O/P	L		E		
Hibiscus syriacus	Hibisc de Síria	Rose of Sharon	S-O/P	S		D		
Jacaranda mimosifolia	Xicranda	Jacaranda	S-O/P	L		D		
Juglans regia	Noguera	Common walnut	O/P	L	IR	D		Difficulty adapting
Koelreuteria paniculata	Sapindal	Golden rain tree	S-O/P	M	IR	D		
Koelreuteria paniculata 'Fastigiata'	Sapindal	Golden rain tree	S-O/P	M		D		
Lagerstroemia indica	Arbre de Júpiter	Crape myrtle	S-O/P	S	IR	D		Difficult to plant
Laurus nobilis	Llorer	Sweet bay	O/P	L		E		Vulnerable to diseases
Leucaena leucocephala	Aromer blanc	White leadtree	S-O/P	M	IR	E		
Ligustrum lucidum	Troana arbòria	Glossy privet	S-O/P	M	IR	E		Invasive
Liquidambar styraciflua	Liquidàmbar americà	Liquidambar	S-O/P	M		D		Difficulty adapting
Liriodendron tulipifera	Tuliper de Virgínia	Tulip tree	S-O/P	M		D		Difficulty adapting

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Maclura pomifera	Maclura	Osage orange	O/P	L		D		Unsuitable for streets
Magnolia grandiflora	Magnòlia	Evergreen magnolia	S-O/P	M	IR	E		Needs a lot of water and nutrients
Magnolia grandiflora 'Pyramidalis'	Magnòlia	Evergreen magnolia	S- ZP	M		E		Needs a lot of water and nutrients
Malus 'Everest'	Pomera everest	Apple	S-O/P	S	IR	D		
Melia azedarach	Mèlia	Indian bead tree	S-O/P	M		D		
Morus alba	Morera blanca	White mulberry	O/P	L		D		Produces a lot of fruit, which fouls pavements
Morus alba 'Fruitless'	Morera blanca	White mulberry	S-O/P	L		D		
Morus alba 'Kagayame'	Morera blanca	White mulberry	O/P	L		D		Produces a lot of fruit, which fouls pavements
Morus nigra	Morera negra	Black mulberry	O/P	L		D		Produces a lot of fruit, which fouls pavements
Nerium oleander	Baladre	Falta traducció	S-O/P	S	IR	E		
Olea europaea	Olivera	Olive	O/P	M		E		Unsuitable for streets
Ostrya carpinifolia	Òstria europea	Hop hornbeam	S-O/P	M		D		
Parkinsonia aculeata	Parkinsònia	Palo verde	O/P	S	IR	D		Branches with thorns
Paulownia tomentosa	Paulònia	Foxglove tree	S-O/P	L		D		
Phoenix canariensis	Palmera de Canàries	Canary Island date palm	S-O/P	L		E		Vulnerable to red palm weevil
Phoenix dactylifera	Palmera de dàtils	Date palm	S-O/P	L		E		Vulnerable to red palm weevil
Photinia x fraserii 'Red Robin'	Fotínia de Fraser	Photinia	S-O/P	S		E		
Phytolacca dioica	Bellaombra	Phytolacca	O/P	L		D		Invasive roots
Pinus halepensis	Pi bord	Aleppo pine	O/P	L		E		Very vulnerable to attack by the processionary caterpillar
Pinus nigra	Pinassa	Austrian pine	O/P	L		E		Difficulty adapting
Pinus pinaster	Pi melis	Maritime pine	O/P	L		E		Difficulty adapting
Pinus pinea	Pi pinyoner	Stone pine	S-O/P	L		E		
Platanus PLATANOR® 'Vallis Clausa'	Plàtan	Plane	S-O/P	L		D		
Platanus orientalis	Plàtan d'orient	Oriental plane	S-O/P	L		D		

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Platanus x acerifolia (P. x hispanica)	Plàtan d'ombra	London plane	S-O/P	L		D		Very common in Barcelona, over 15% of total. Difficulty adapting
Podocarpus neriifolius	Podocarp comú	Brown pine	S-O/P	M		E		
Populus alba	Àlber	White poplar	O/P	L		D		Invasive roots. Branches break easily
Populus alba 'Pyramidalis'	Àlber piramidal	White poplar	S-O/P	L		D		Invasive roots. Branches break easily
Populus nigra	Pollancre	Black poplar	O/P	L		D		Invasive roots. Sheds large amounts of white fluff
Populus nigra 'Italica'	Pollancre gavatx	Lombardy poplar	S-O/P	L		D		Branches break easily. Needs a lot of water
Populus simonii	Pollancre de Simon	Simon's poplar	O/P	M		D		Difficulty adapting
Populus tremula	Trèmol	Aspen	S-O/P	L		D		Invasive roots. Sheds large amounts of white fluff
Populus x canadensis	Pollancre del Canadà	Grey poplar	S-O/P	L		D		Invasive roots. Needs a lot of water. Sheds large amounts of white fluff
Prunus avium	Cirerer	Gean	S-O/P	M		D		
Prunus cerasifera	Mirabolà	Cherry plum	S-O/P	M		D		
Prunus cerasifera 'Pisardii' (P. cerasifera 'Atropurpurea')	Prunera vermella	Purple-leaf cherry plum	S-O/P	M		D		
Prunus domestica	Prunera	Plum	S-O/P	M		D		
Prunus serrulata	Cirerer del Japó	Oriental cherry	S-O/P	M		D		
Prunus serrulata 'Kanzan'	Cirerer de flor	Kanzan cherry	S-O/P	M		D		
Pterocarya fraxinifolia	Noguera del Caucas	Caucasian walnut	S-O/P	L		D		
Punica granatum	Magraner	Pomegranate	O/P	S		D		Unsuitable for streets
Pyrus calleryana 'Chanticleer'	Perera de Callery	Callery pear	S-O/P	S		D		
Quercus coccifera	Garric	Kermes oak	O/P	M		E		Unsuitable for streets
Quercus faginea	Roure valencià	Portuguese oak	O/P	M		D		Unsuitable for streets
Quercus ilex	Alzina	Holm oak	S-O/P	M	IR	E		

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Quercus pubescens	Roure martinenc	Downy oak	S-O/P	M	IR	D		
Quercus robur	Roure pènol	English oak	S-O/P	L	IR	D		
Quercus robur 'Fastigiata'	Roure pènol	English oak	S-O/P	L		D		
Quercus suber	Surera	Cork oak	O/P	M		E		Difficulty adapting
Robinia pseudoacacia	Robinia	Black locust	O/P	L		D		Uneven growth. Invasive
Robinia pseudoacacia 'Bessoniana'	Robinia	Black locust	S-O/P	M	IR	D		
Robinia pseudoacacia 'Casque rouge'	Robinia	Black locust	S-O/P	M	IR	D		Branches break easily
Robinia pseudoacacia 'Pyramidalis'	Robinia	Black locust	O/P	M		D		Breaks easily. Invasive
Robinia pseudoacaia 'Umbraculifera'	Robinia	Black locust	S-O/P	M		D		Branches break easily
Salix alba	Salze blanc	White willow	O/P	L		D		Difficulty adapting
Salix babylonica	Desmai	Chinese weeping willow	O/P	M		D		Difficulty adapting
Salix elaeagnos	Sarga	Hoary willow	O/P	M		D		Difficulty adapting
Salix x sepulcralis	Salze pèndul	Golden weeping willow	O/P	L		D		Difficulty adapting
Schinus molle var. areira	Pebrer bord comú	Pepper tree	O/P	L	IR	E		Unsuitable for streets
Schinus terebenthifolius	Pebrer bord del Brasil	Brazilian pepper	O/P	M		E		Unsuitable for streets
Styphnolobium japonicum (Sophora japonica)	Sòfora	Pagoda tree	S-O/P	M		D		
Syagrus romanzoffiana (Arecastrum romanzoffianum)	Palmera de la reina	Queen palm	S-O/P	M		E		
Tabebuia heptaphylla	Tabebria	Pink trumpet tree	S-O/P	M		D		
Tamarix africana	Tamariu africà	African tamarisk	S-O/P	S	IR	D		
Tamarix gallica	Tamariu francès	French tamarisk	S-O/P	S	IR	D		
Tamarix ramosissima (T. pentandra)	Tamariu d'estiu	Summer-flowering tamarisk	S-O/P	S	IR	D		
Tetradium daniellii	Arbre de les mil flors	Bee-bee tree	S-O/P	L		D		

Species	Catalan	English	Uso	Medida	Porte	Tipo		Suitability in Barcelona
Tilia cordata	Tell de fulla petita	Small leaved tree	S-O/P	L		D		Difficulty adapting
Tilia x euchlora	Til·ler de Crimea	Caucasian lime	S-O/P	L		D		Difficulty adapting
Tilia x europaea	Til·ler d'Holanda	European lime	S-O/P	L		D		Difficulty adapting
Tlia platyphyllos	Til·ler	Large-leaved lime	S-O/P	L		D		Difficulty adapting
Tilia tomentosa	Tell argentat	Silver lime	S-O/P	L		D		Difficulty adapting
Tipuana tipu	Tipuana	Tipu tree	S-O/P	L		D		
Trachycarpus fortunei	Margalló de la Xina	Chusan palm	S-O/P	S		E		
Ulmus americana	Om americà	American elm	S-O/P	L	IR	D		Difficulty adapting
Ulmus 'Dodoens'		'Dodoens' elm	S-O/P	L	IR	D		Difficulty adapting
Ulmus minor 'Umbraculifera'	Om	Field elm	S-O/P	S		D		Difficulty adapting
Ulmus pumila	Om de Sibèria	Siberian elm	S-O/P	L	IR	D		Vulnerable to Dutch elm disease. Breaks easily. Invasive roots
Ulmus resista 'New Horizon'	Om resista	Resistant elm	S-O/P	L		D		
Washingtonia filifera	Washingtònia de California	Petticoat palm	S-O/P	L		E		
Washingtonia robusta	Washingtònia de Mèxic	Mexican fan palm	S-O/P	L		E		
Zelkova serrata 'Green vase'	Zelkova del Japó	Japanese Zelkova	S-O/P	L		D		

Key

Use

O/P: : tree suitable for use in open spaces or parks
S: tree suitable for use in streets

Medida

L: large
M: medium-sized
S: small

Tipo

E: evergreen
D: deciduous

Porte

- Parasol-shaped
- Spindle-shaped
- Columnar
- Conical
- Elliptic
- Spherical
- Uneven
- Drooping
- Ovoid
- Palmiform
- Pyramidal
- Semi-ovoid
- IR Uneven

Suitability as a street tree in Barcelona

- Planting recommended, both as a replacement and for new planting
- Planting subject to restrictions. Only as a replacement in those streets where the species is maintained. Avoid new planting
- Avoid planting
- Species under study

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