



TREES FOR LIFE

Master Plan for Barcelona's Trees
2017 - 2037



Ajuntament de
Barcelona



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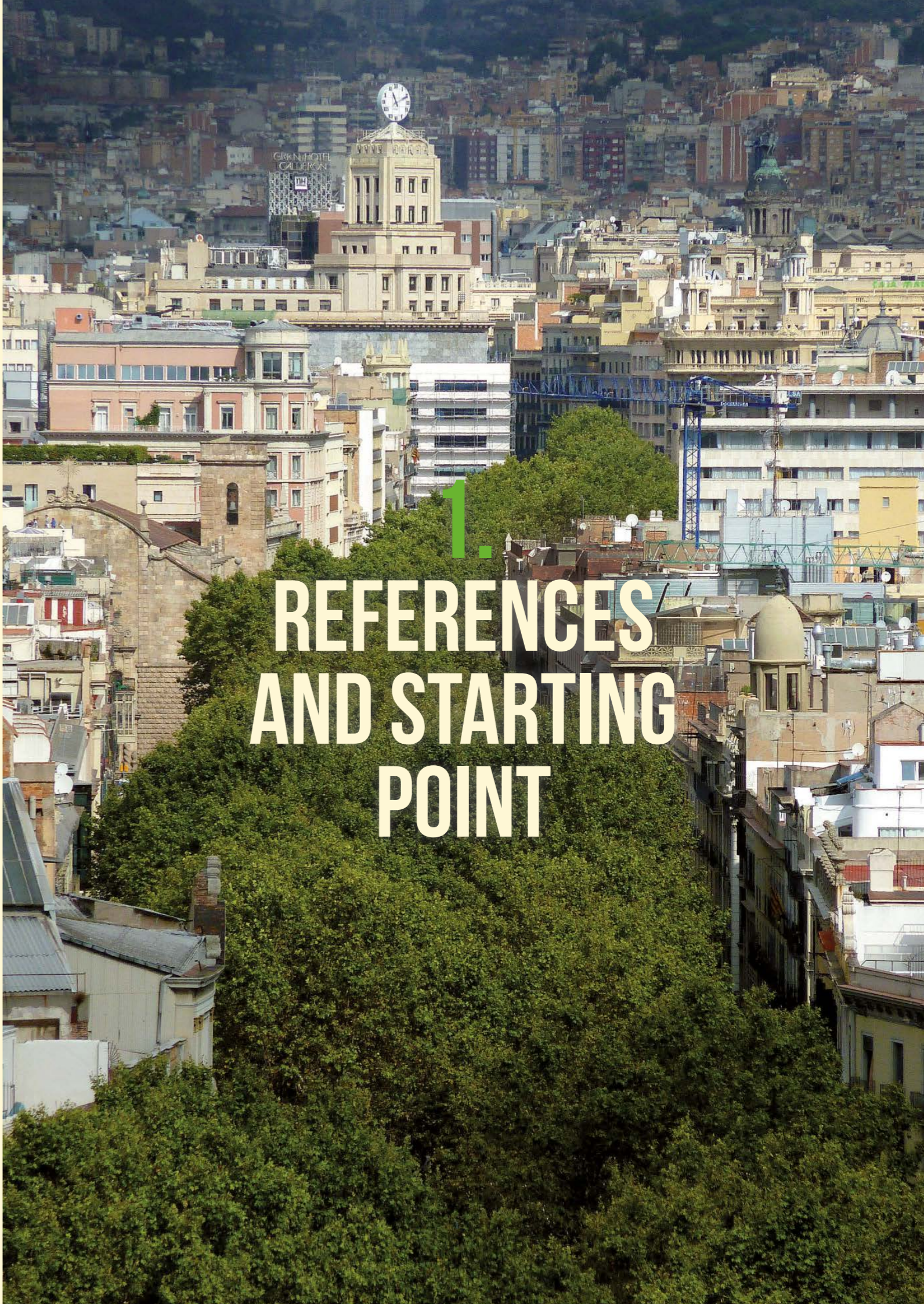
CONTENTS

1. REFERENCES AND STARTING POINT 3

1.1. Introduction. Our neighbours, the trees	4
1.2. Trees are alive	6
1.2.1 How do trees work?	6
1.2.2. Trees in the city: biogeographical and urban factors	7
1.3. The ecological and social values of urban trees	10
1.3.1. Urban Canopy	10
1.3.2. Trees as an essential part of a green infrastructure	10
1.3.3. Services and benefits of trees	11
1.3.4. Some disadvantages of trees	14
1.4. Barcelona's trees	15
1.4.1. A little history	15
1.4.2. Tree inventory	15
1.4.3. Municipal planning and management criteria for trees	17
1.4.4. Publicly and privately owned trees	20
1.5. Technological innovation at the service of urban green areas	22

2. THE ACTION PLAN: STRATEGY AND PROPOSALS 23

2.1. Vision, objectives and challenges	24
2.2. Strategic lines and actions	26
2.3. Operational schedule	34
2.4. Budget and Investment	36
2.5. Governance of the Plan	38



1.1. INTRODUCTION. OUR NEIGHBOURS, THE TREES

The City of Barcelona is facing major challenges in the 21st century in terms of improving its population's health and comfort. These require the development of a sustainable, equitable and inclusive city, with improvements to fundamental features like environmental quality, especially in relation to the pollution generated by fossil-fuel vehicles, the urban land balance and public services for all of the municipality's neighbourhoods, decent housing, the fight against climate change and responding to migratory movements. According to the United Nations, cities today contain 54.5% of the population, and it has been estimated that by 2050, that figure may rise to 70%, making cities the main player for tackling the global challenges of the world's population.

The city's green infrastructure, and especially its trees, plays a fundamental role in local policies aimed at improving the metabolic functioning of urban systems, the city's habitability and the health of its population. A green infrastructure that is correctly planned, developed, managed and maintained contributes to the city's human and ecological development, to the point of becoming a life-support system.



Parc del Centre de Poblenou

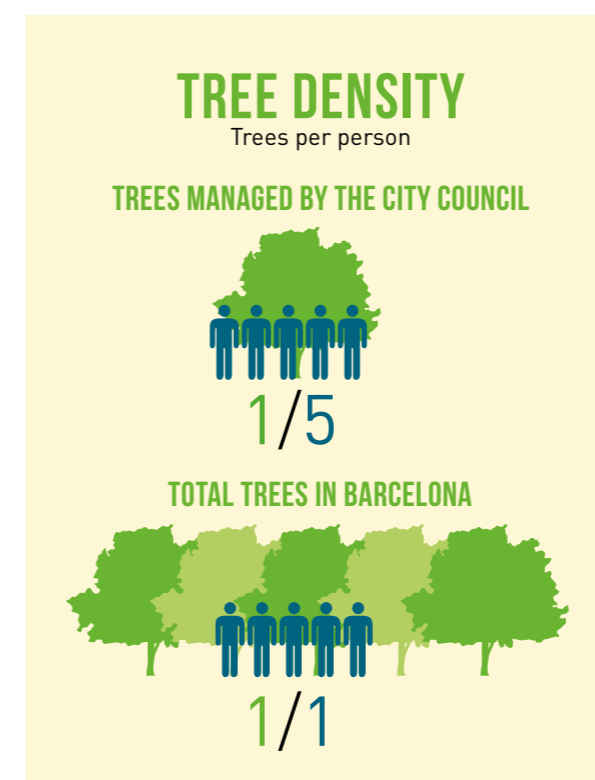
Trees in the urban environment are living organisms that live with people and provide them with a physical and emotional connection to nature. The city's trees make it possible to interconnect the city's green areas, favouring a green infrastructure around which the city is organised, which contributes to health, comfort and habitability, due to their effects on environmental quality, the beauty of urban landscapes or the creation of areas for socialising and coming into contact with nature in the urban environment. For many people, trees are the fragment of nature that they have closest to hand, a living "neighbour" who is present throughout their lives, contributing to a healthier and more habitable city. Among other things, they mark areas of community life and interaction, seasonal changes and the passage of time.

According to the report "Statistics on the Population of Barcelona 2016 - A Study of the Municipal Residents Registry", on 1 January 2016, there were 1,610,427 people registered as Barcelona residents, in 655,175 homes (Statistics on the Population of Barcelona, 2015). In the last five years, the number of people over the age of 65 has gradually increased to around 21%, while the number of children is unchanged at around 12%. Life expectancy for Barcelona residents is 80.5 years for men and 86.7 years for women (Data from 2014. the "Health in Barcelona 2015" report). A little over half the population was born in Barcelona, while nearly a quarter were born abroad. This population data for Barcelona reflects the profound changes that Barcelona society has undergone in recent years.

Currently over 80% of Barcelona's municipal area has been developed or is developable land, while the remaining 20% is made up of woodland (mainly the Serra de Collserola Natural Park). 56% of the city's developed land is occupied by buildings. It is estimated that there are over 1.4 million trees in the Barcelona municipal area, making up a large tree mass covering 25.20% of the land (according to the study "Ecological services of Barcelona's urban green areas, CREA, 2009"). This figure includes trees in the woodland areas of Collserola, Montjuïc and Tres Turons, and those in streets, parks, and public and private gardens.

The **urban agenda's new challenges** and the increasing complexity of the city make it necessary to review and update the planning instruments and management of the elements making up the city's systems, such as **the trees and the green infrastructure**, in order to contribute to **equitable, healthy development** that is good for people. The appropriate planning and management of the city's **tree heritage** can also contribute to improving their contribution as living entities to the health of the population and the habitability of Barcelona.

This is the reason behind the Master Plan for Barcelona's Trees, the strategic municipal document that defines the vision, objectives, strategic lines and actions for the planning, management and conservation of the city's tree population, both public and private, in accordance with their biogeographical and urban characteristics, in order to guarantee the contribution of those trees to a healthier city for the current population as a whole and for future generations, where the naturalisation and extension of green areas is a key factor for creating living, habitable public areas for people.



1.2. TREES ARE ALIVE

In order to care for and promote the value of the trees in our city, we need to know all about their nature as living beings and their specific needs in terms of natural resources (sunshine, water, temperature and humidity, nutrients, etc.) and living space, so that they grow well and have a full life cycle.

1.2.1

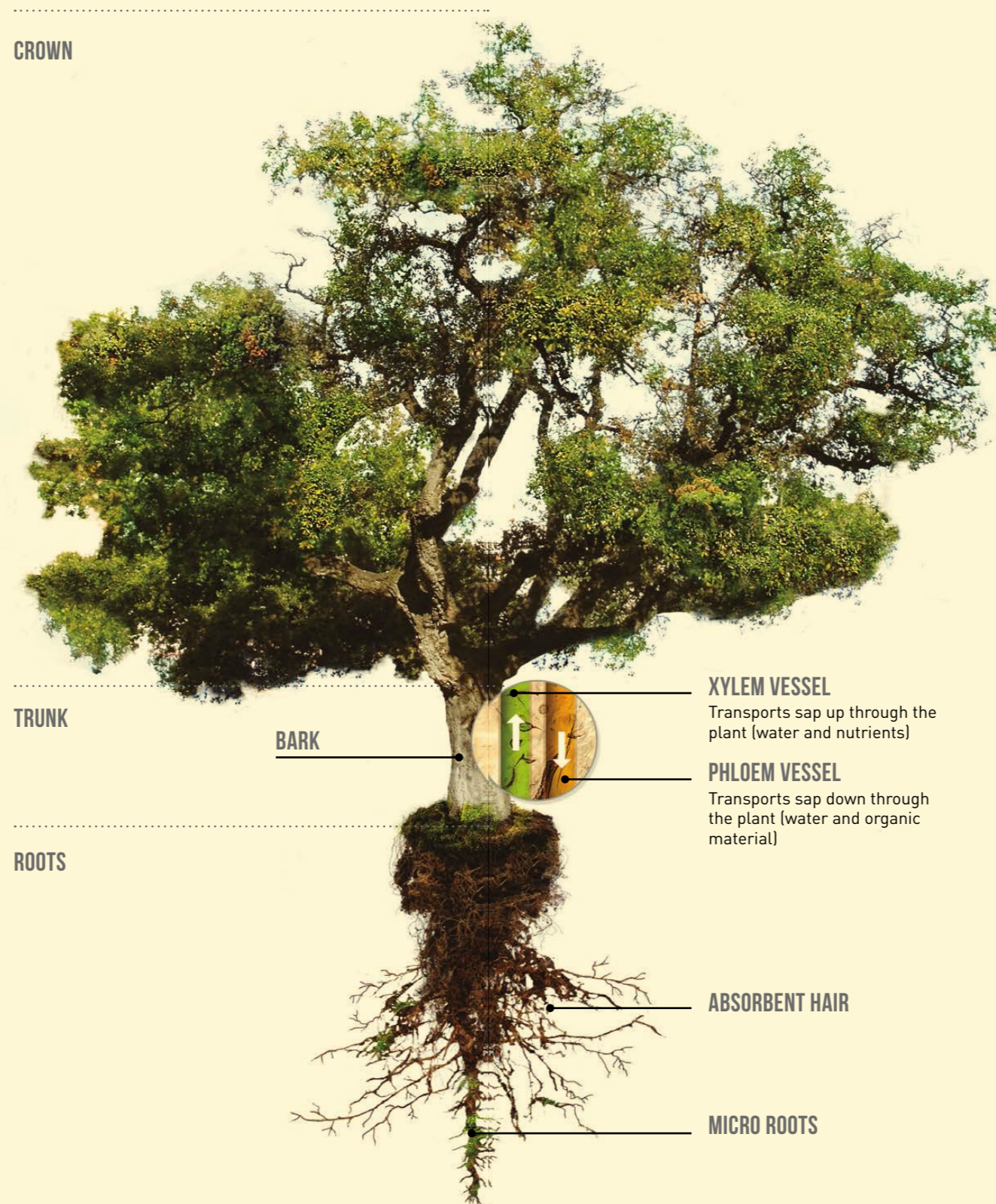
How do trees work?

A tree has three main parts:

The crown: the aerial, visible part made up of the tree's branches, leaves and fruit. The leaves are responsible for making the organic material, where transpiration and evapotranspiration (emission of oxygen and evaporated water) take place. Part of the solar energy is absorbed by chlorophyll (between 1 and 3%). This is where most of the fauna that inhabit trees live (small reptiles, birds, insects, etc.). A group of trees in good condition generates a tree mass of high ecological value in the urban green infrastructure system.

The trunk: the thick, woody main stem that contains an architecturally complex system of vessels used for transporting the tree's sap.

The roots: are responsible for supporting the structure and providing the tree with water and nutrients from the soil. For this reason, the quality and quantity of soil are of fundamental importance. There may be a single descending root, with secondary lateral roots branching out from it (tap root system) or various descending main roots (branched radicle system). They usually cover an area as large or larger than the aerial part of the plant. Root hairs absorb water and nutrients from the soil. The mycorrhiza are fungi that surround the roots, increasing the surface area for absorbing water and nutrients.



The bark is the external part of roots, trunk and branches. In a busy, crowded urban environment like Barcelona, the bark protects the tree's interior parts from impacts and diseases.

1.2.2.

Trees in the city: biogeographical and urban factors

Each tree species is adapted to growing in specific biogeographical and environmental conditions. It is important to remember this as a starting point when devising a plan to define the strategic guidelines and actions for the planning and management of urban trees.

As living beings, trees have physical characteristics, a life cycle and physiological demands that determine their growth and their ability to survive in a given habitat (water demand, range of temperature and humidity, availability of nutrients, etc.). These characteristics must be taken into account, especially when trees are planted outside their natural environment.

In general, urban environments do not offer trees the best living conditions. For this reason, the growth of a tree planted in the street differs notably from that of a tree of the same age and species in natural conditions or even planted in a park or any other naturalised environment, especially in the case of more sensitive and fragile species.

Factors such as the width and orientation of the street, how much soil is available, the type of surfacing, the height of buildings, how much sunlight it gets, the use of the surrounding buildings, traffic density, etc. all have a notable impact on the ability of each species to survive. The limiting factors do not only affect the well-being of the visible, aerial part of the tree, which everyone can see, but also the root system, which is of vital importance for its growth and is often

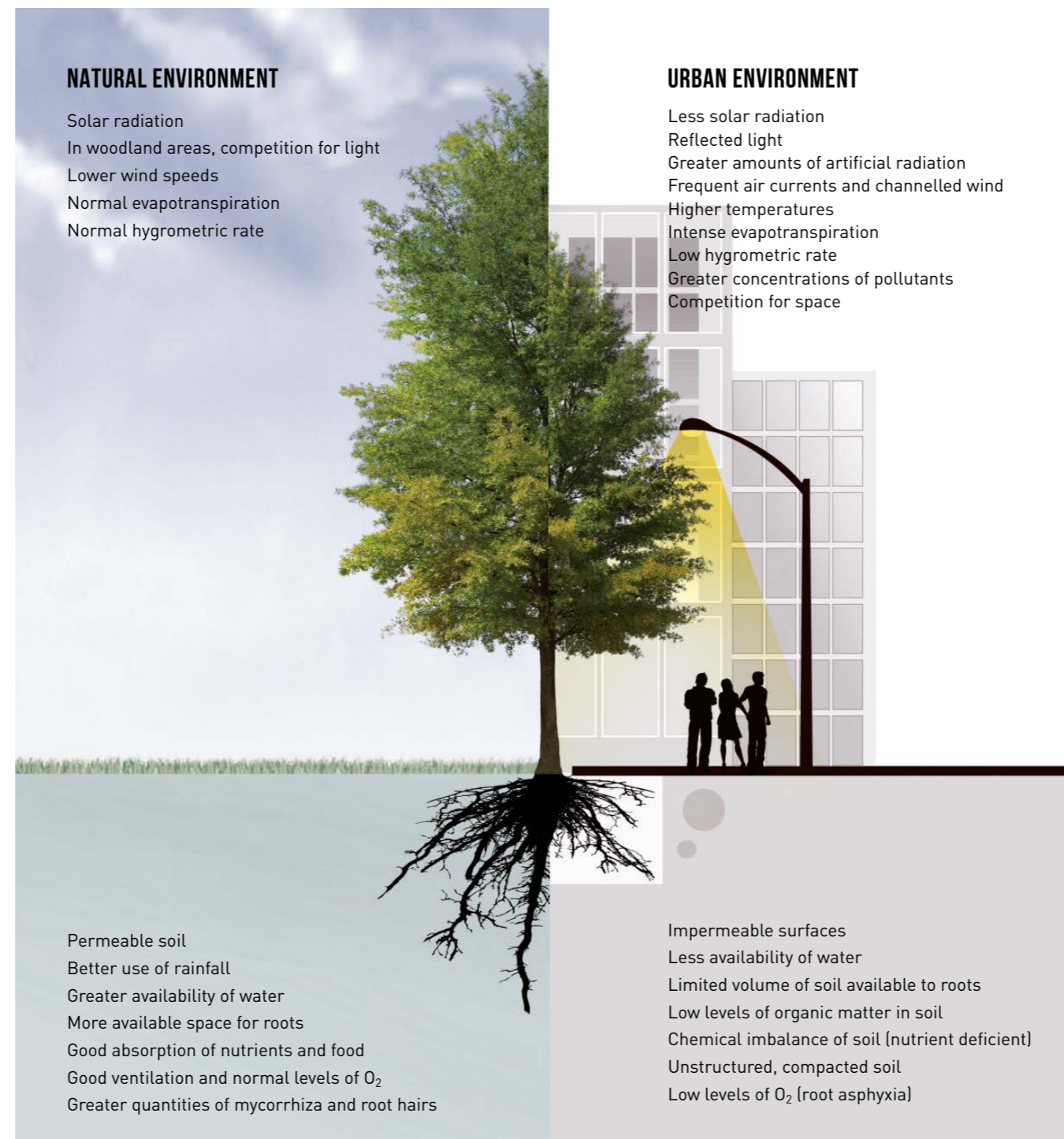
ignored. Taking this into account when there are roadworks is of key importance for maintaining trees in good condition.

Urban settlements grow outwards, putting pressure on and fragmenting natural systems in their path, transforming the landscape and affecting the dynamics of ecosystems and their biological diversity. The extensive growth of cities, their increasing complexity, the consequent distancing from nearby natural environments and the general public's demand for better urban quality all mean that there is a need to progressively make urban environments more natural by means of creating new green areas and planting trees in the street.

Barcelona is characterised by the compact, dense nature of its urban structure, something that, since olden times, has fostered the city's mixed, diverse Mediterranean character. Geography has also played its part in its urban development, as the Serra de Collserola mountains and the sea have always acted as natural limits. The progressive occupation of the plain of Barcelona led to the former mosaic of open spaces, made up of cultivated land, wooded areas and gardens, being replaced. The density and extent of the city have meant that fitting in nature, in the form of parks, gardens and trees, has often been difficult, due to the lack of space, the street layout and the location of buildings. Therefore, it is now necessary to make a proactive effort to promote the naturalisation of the city and increase its biodiversity.

The municipality of Barcelona has a surface area of 102.2 km² between the Serra de Collserola mountains, the seashore and the Besòs and Llobregat rivers. The city is characterised by a dense, compact urban fabric, with a high density of motor-vehicle traffic, especially in the city centre, and an atomised, discontinuous network of green areas that are not always connected to the natural environments surrounding the city. However, there are a large number of trees in the urban area.

CONDITIONING FACTORS FOR TREES



(COMPARISON BETWEEN NATURAL AND URBAN ENVIRONMENTS)

As mentioned above, in order to determine which trees are most appropriate for the city, it is essential to take into account the biogeographical and climatic factors, as the particular characteristics of the Mediterranean climate, with mild winters and hot, dry summers, with lots of sunshine and irregular rainfall over the year, subject vegetation to levels of stress that some non-native species cannot tolerate or have difficulty in tolerating. It is true that modern urban gardening techniques, the varieties selected and the management and maintenance efforts invested often compensate for these difficulties, but from both an ecological and economic point of view, logic dictates that operational criteria be adapted as much as possible to climatic conditions, **using native species instead of trying to reproduce landscapes that are natural to other latitudes.**

This concept is even more pertinent given the proven effects of climate change and projections that foresee major changes in rainfall and temperatures in the Mediterranean area, as in other regions of the planet, which will also affect the types of vegetation that can be grown naturally. **An urban green infrastructure adapted to lower rainfall and an even more irregular distribution of rainy weather, an increasing number of heat waves and higher levels of solar radiation, will have greater chances of success and lower maintenance costs than one that is less well adapted.** This adaptation to climate change is especially relevant to the trees in our streets and squares, because the stress factors are higher than for trees in more favourable locations, such as parks and gardens.

1.3. THE ECOLOGICAL AND SOCIAL VALUES OF URBAN TREES

1.3.1. Urban Canopy

Without dismissing trees as individuals, the **Master Plan for Barcelona's Trees 2017-2037** refers to the city's trees not from an individual point of view, but as a tree population, or an urban canopy, taking into account the ecological, environmental, social and landscaping services that they provide the city as living organisms.

This approach to urban trees is in line with a growing tendency in the public management of green areas all over the world. It understands trees to be part of a whole, given the name *urban canopy* or *urban forest*. The Plan values trees for the importance of the services and beneficial effects they provide to the population in every city district, including both the groups of trees located in gardens, parks and natural areas that make up woodland, and each of the trees lining the city's streets and avenues, which form groups of trees within the urban area.

1.3.2. Trees as an essential part of a green infrastructure

Trees are a vital part of an urban green infrastructure. They structure public areas and provide fundamental services for urban environmental quality and for people's health and well-being. They form a network that interconnects all the city's green areas and habitats, providing multiple social-environmental and economic functions and benefits, making them just as necessary as any other service.

A well-planned, developed and managed green infrastructure becomes a life-support system that creates strong connections between trees and people. For this reason, it must be subject to certain functional, operational and aesthetic intervention criteria, which help it to find its place in public spaces and achieve a balanced coexistence with other infrastructures. Collaboration between those responsible for the planning and management of the city's roadways, private owners and tree experts is therefore essential for ensuring that trees are planted in all areas of the city and streets where they can grow as healthily as possible and, at the same time, maximise the functions they offer.

However, the concept of green infrastructure is not limited to observing these strictly urban services; it also involves those that concern the territory's ecological quality, beyond built-up areas. A tree population conceived as a functional network helps to connect the city's green areas with the forest and river ecosystems surrounding Barcelona, creating a more integrated and uniform green landscape and helping to increase biodiversity, thanks to their function as a corridor and connector of open spaces.



Green infrastructure of the Eixample district, Barcelona

1.3.3. Services and benefits of trees

City trees contribute decisively to improving the quality of people's lives, due to their environmental and social benefits for the population, and they are considered to be an essential urban feature for defining the urban structure of cities and for evaluating the quality of public areas.

The social and environmental benefits they provide have a direct positive impact on people's health and well-being, which is why trees are an essential feature in the city.

1.3.3.1

Environmental benefits

IMPROVING AIR QUALITY

Trees help to purify the air by eliminating atmospheric pollutants, mainly caused by motor-vehicle traffic and industry. These include ozone, sulphur dioxide, nitrogen dioxide, carbon monoxide and suspended particles.

According to the study "Ecological Services of Urban Green Areas in Barcelona" (CREAF, 2009), the city's trees and bushes eliminated over 305 tonnes of polluting compounds in 2008. 1,006 tonnes of PM₁₀ particles, 72.6 tonnes of O₃, 54.6 tonnes of NO₂, 6.8 tonnes of SO₂ and 5.6 tonnes of CO. This service has an estimated value of €1.1 million. Above all, trees retain PM10 particles, and progressively smaller amounts of O₃, NO₂, SO₂ and CO.

NOISE REDUCTION

Trees help to minimise the acoustic pollution reaching people's homes, in both real and perceived terms, because their crowns act as a barrier.

MICRO CLIMATIC REGULATION AND ENERGY SAVING

The shade offered by trees and the humidity that vegetation gives off help to cool the atmosphere and lower temperatures during the hotter months. In winter, they also help to reduce wind speeds, which attenuates the drop in temperature and reduces the need for using energy to heat homes.

RAINWATER RETENTION

Trees help to retain rainwater in the subsoil and favour its use as a groundwater resource, compensating for the problems associated with impermeable surfaces in urban areas.



INCREASED ANIMAL BIODIVERSITY

Trees are attractive habitats for fauna, as a refuge for living, as a stopover en route to another location (between green areas and woodland), or as a source of food. On city streets, where trees are usually distributed in one or two lines, the main vertebrate animals that use them are birds. Larger trees, with fully developed crowns, have spaces and cavities that are also occupied by small reptiles or bats.

GREEN CORRIDORS

Good quality urban trees, which form a considerable tree mass, act as a connector between various isolated green areas and favour the flow of biodiversity between the city and its surrounding natural areas.

1.3.3.2

Social and health benefits

POSITIVE EFFECTS ON PEOPLE'S HEALTH

According to the conclusion of the British report "Benefits of green infrastructure" (2010, Forest Research), a green infrastructure has a positive effect on life expectancy and the reduction of health inequality, due to the psychological and physical benefits arising from the physical and social activities undertaken by people in contact with nature. This reduces risks to mental health, circulatory problems, obesity, etc., with consequent savings in public health expenditure.

ESTABLISHMENT OF EMOTIONAL LINKS

For many people, following the life cycle of trees - flowering, growth, loss of leaves- is also their closest connection with nature, to the point where an emotional link is often established (biophilia).

CREATING MEETING PLACES

The shade offered by trees makes comfortable places for human activities, giving rise to greatly valued places for socialisation and social cohesion, especially for groups who spend more time outside, such as children, young people, senior citizens and newcomers.

1.3.3.3

Benefits for the urban landscape

TREES AS STRUCTURAL ELEMENTS

Trees are a feature that helps to structure and urbanise a city, creating a variety of environments, establishing relationships between different areas of the city and giving certain city places or streets individuality.

THE QUALITY OF PUBLIC AREAS

Trees provide public areas with a variation of colour and shapes, breaking up the monotony of buildings, improving the aesthetic perception of the city and its habitability.

1.3.4.

Some disadvantages of trees

As we have seen, the presence of trees in the city provides a lot of benefits. However, they are living beings and various problems they may cause must also be taken into consideration. Some of these disadvantages, or in the language used by the arboricultural sector, disservices, include causing allergies, the emission of VOCs (volatile organic compounds), negative effects on road surfaces and pavements, the presence of leaves, flowers and fruit on pavements, etc.

These disadvantages must be taken into account, as part of proper planning, by diversifying the species and avoiding those that cause most problems.

This Plan aims to maximise the benefits and minimise the disadvantages as far as possible.



Passeig Lluís Companys



Palau de Pedralbes Gardens

1.4. BARCELONA'S TREES

1.4.1.

A little history

The original nature of the land where the city of Barcelona now lies has been greatly modified since the first human settlements. The original ecosystems have been progressively altered due to human activity, which increasingly exploited natural resources as the population became established in the area. Immediately before the appearance of the first settlements, holm oak woods covered the Plain of Barcelona, the slopes of Collserola and other hills. The shady areas were dominated by holm oak groves, and the rocky, sunny places were dominated by Aleppo pines. The Besòs and Llobregat river basins had riparian woodland (black and white poplars, elms, alders, etc.).

Human activity progressively replaced the holm oak woods with agricultural land, where there were orchard trees, including orange trees, lemon trees, cherry trees and fig trees, along with olive trees, carob trees, almond trees, walnut trees

and mulberry trees. In private areas of the city, there were private orchards and gardens, which carried on the tradition of Roman gardens in house interiors.

This vegetation dominated the landscape until the middle of the 19th century, when the city walls were demolished, the Pla Cerdà for expanding Barcelona was formulated and surrounding towns were annexed into the city. This large-scale land transformation included the planting of trees at the sides of roads as a structural feature of the city layout and to create shade for people's well-being. There were also plans for planting double lines of trees on one pavement of each city block and gardens in the interiors of each block. Unfortunately, Cerdà's initial project was undermined in terms of green areas and only one line of trees was planted in the streets, mostly plane trees. In the 20th century, the construction of city squares and gardens was planned and executed, and over the years, new green areas were included, originating from country houses and private estates that became public property.

Barcelona's trees also include species such as the tipuana (rosewood) and the blue jacaranda, which have been included in the inventory of existing adapted species as introduced species. Nowadays, trees are present throughout the city, and have become one of Barcelona's most singular identifying features.

1.4.2.

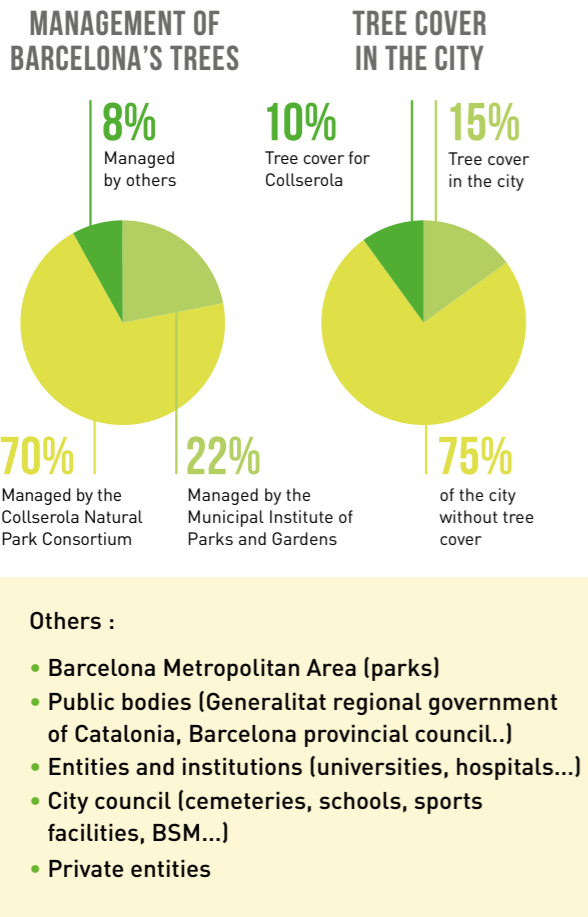
Tree inventory

All Barcelona's trees are considered to be part of the city's tree heritage, including both those living in public property and those in private property. Barcelona City Council is responsible for managing the trees that are municipal property, but it is also responsible for conserving the city's tree heritage as a whole. Regarding the number of trees, two different sources are used: the city's global data, obtained by the Ecological and Forestry Applications Research Centre (CREAF, 2009), and the tree data administered by the Municipal Institute of Parks and Gardens, obtained by carrying out an inventory of the territory.

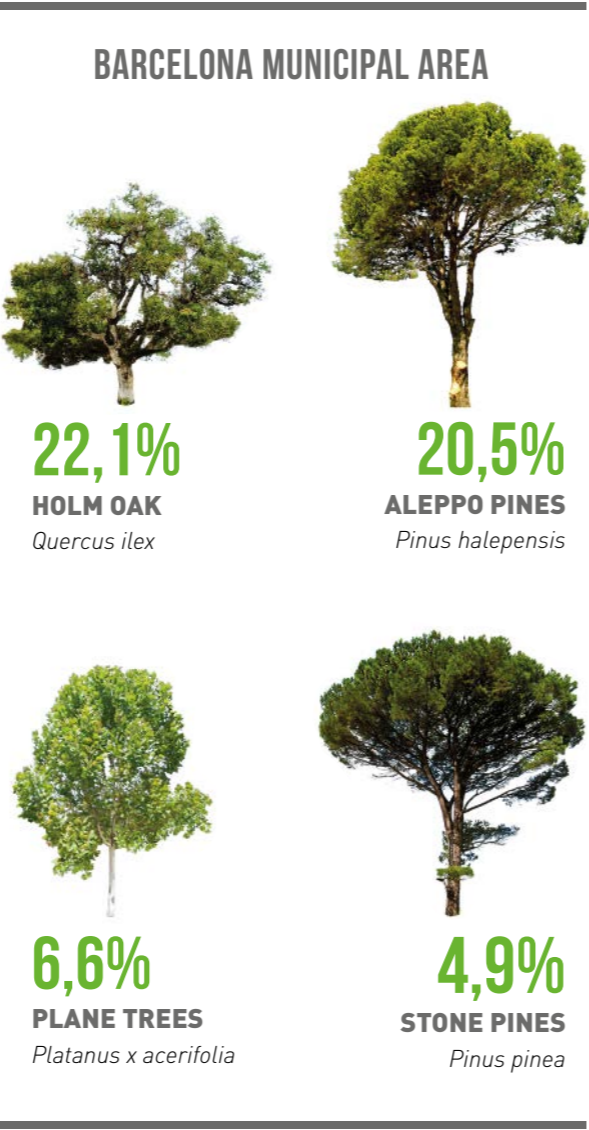
It has been calculated that there are **over 1.4 million trees** within Barcelona’s municipal boundaries, according to the study “Ecological Services of Urban Green Areas in Barcelona”, produced by CREAM using UFORE.

UFORE is a programme designed by the US Department of Forestry and Agriculture. It works by using a sample of the territory, which allows researchers to quantify and evaluate urban forest structures and their environmental benefits.

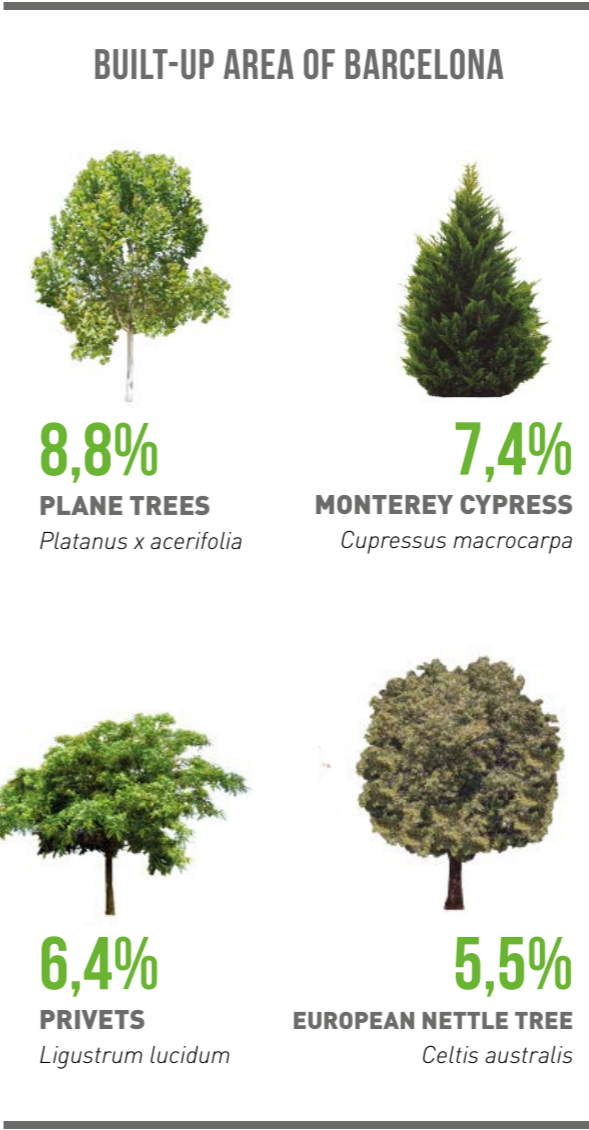
This approximate figure, reached using a statistical estimate, includes all the trees within municipal boundaries, including the Serra de Collserola. This tree mass covers 25.20% of Barcelona’s municipal area. This large tree biomass provides first-class environmental services and constitutes a natural heritage site of great value.



According to this study, the **most common trees in the Barcelona municipal area** (including the Serra de Collserola) are the **holm oak** (*Quercus ilex*) with 313,372 individuals (22.1% of the total population), **Aleppo pines** (*Pinus halepensis*) with 290,525 individuals (20.5%), **plane trees** (*Platanus x acerifolia*) with 93,212 individuals (6.6%) and **stone pines** (*Pinus pinea*) with 69,749 (4.9%).



The same study shows that the **most common trees inside the built-up area of Barcelona** are **plane trees** (*Platanus x acerifolia*), with 18,744 individuals (8.8% of the urban population), the **Monterey cypress** (*Cupressus macrocarpa*) with 15,620 individuals (7.4%), **privets** (*Ligustrum lucidum*), with 13,668 trees (6.4%) and the **European nettle tree** (*Celtis australis*), with 11,715 individuals (5.5%).



1.4.3. Municipal planning and management criteria for trees

Barcelona’s street trees have been around for a hundred years, and their importance to the city has increased in proportion to the number of individual trees, while their management has become more complex.

As with all other urban infrastructures, the place of trees in the city is conditioned by the characteristics of the streets and squares and by the necessary coexistence of uses, functions and services within a physically-limited urban environment. However, unlike the other services, such as lighting, traffic lights, bus shelters and municipal waste containers, trees are living organisms and often end up interacting with the other static elements around them. The various planning and management instruments, along with the regulations and recommendations developed by Barcelona City Council through its various governmental and technical departments, define the criteria which each public service has to comply with in order to properly fit in.

With the aim of providing the public management of trees with the most appropriate planning and intervention instruments at any given time, the City Council has produced various documents and regulations that specify the procedures to follow when administering public areas and guaranteeing healthy trees that are functional from a an environmental and social viewpoint.

In 1995, the City Council produced a Green Area Plan for Barcelona, which included the **Strategic Plan for Transforming Barcelona’s Street Trees**. This plan proposed the introduction of a greater variety of plants, balancing out the proportion of the most common species and substituting those that showed adaptation problems.

In 1998, the **Plan for Street Tree Management in the Eixample district** was drafted. This proposed specific solutions to tree problems in that district, where, at that time, the largest

proportion of city trees was to be found. The plane tree, the dominant species, had the largest proportion of sick individuals showing evident signs of ageing. The document identified which streets would keep their plane trees and which species would be planted in boulevards, avenues and alleyways. The City Council also began a project of planting trees with colourful flowers on the corners of the district's various neighbourhoods.

The **2004 Street Tree Management Plan**, presented to the Municipal Council's Commission for Sustainability, Urban Services and the Environment during its session on 16 November 2004, included the technical criteria applied to ensure the comprehensive management and sustainability of trees, also taking into account the various aspects involved in tree management: a computerised inventory, selection of species, maintenance, plant protection, health and safety, environmental questions, logistics and communication and information. These criteria were later specified in the document **Management of Barcelona's Street Trees**, presented in 2011, which outlined the principles of creating a diverse, identifiable landscape, increasing biodiversity and carrying



Great tit

out safe, effective management. Its guidelines for tree management, specifically the selection of species, planting, pruning, watering, visual analysis, phytosanitary treatment, protection and an inventory and data control, are currently in operation.

In 2013, Barcelona City Council presented the **2020 Plan for Barcelona's Green Areas and Biodiversity**. The plan proposes the ideas, challenges and lines of action that will guide middle and long-term municipal actions, and the municipal government's commitments regarding the conservation and revitalising of the city's biological diversity and habitats. For the first time, Barcelona has a unified planning instrument for the city's natural heritage. The plan mentions trees as a fundamental part of that heritage.

The Barcelona Green Area and Biodiversity Plan 2020 proposes various lines of action, aimed at:

1. Conserving and improving the city's natural heritage
2. Avoiding any loss of species or habitats
3. Achieving the maximum possible amount of green surface area and its connectivity.
4. Obtaining the maximum possible environmental and social services for green areas and biodiversity.
5. Raising the value that society assigns to green areas and biodiversity
6. Making the city more resilient to emerging challenges, such as climate change



Parc de Joan Miró

MORE TREES AND BETTER TREES

Every tree, and by extension, every specific species, is a unique element that cannot simply be planted in a certain place in a public area, trusting that the efforts of municipal specialists will ensure that the tree adapts successfully. All too often, this expertise and effort is not enough, because a tree's needs and the determining factors specific to each place limit their ability to adapt.

Every tree therefore needs a specific place and a certain quantity of soil and space to grow in. So properly identifying these needs leads to the optimisation of care and maintenance costs while maximising the social and environmental services that trees offer. The quality of trees becomes a valuable asset that is just as important as the quantity of trees, as is shown by the fact that in some areas of the city, the high number of trees ends up being a problem, due to the difficulties of adaptation and the deficiencies that this causes in some species. This means that different criteria should be applied in every city location, and in some cases, not planting trees, but applying other urban naturalisation formulas instead.

High-quality, healthy trees offer many more services and functions for the general public's well-being.

This plan involves 68 actions, many of which concern trees. For example: diversifying tree species; improving the management of green areas and street trees; increasing the city's biomass by increasing the number of trees and bushes in parks, gardens and public and private areas; promoting green-area connection projects in both urban and metropolitan environments (network of green corridors); incorporating efficiency criteria that limit hydrological resources and maintenance, improving applied knowledge on the effects of vegetation on people's health; fostering research into the effects of climate change; preserving emblematic species and providing information on trees of local interest in Barcelona. New urban projects, the redevelopment of streets or the periodic renewal of those services and their features, including trees, are opportunities to coordinate all municipal technical teams and reach an agreement on renewing and improving these intervention criteria.

One of the challenges facing the **Master Plan for Barcelona's Trees 2017-2037** is to strengthen the collaboration between Barcelona City Council's various areas and departments regarding the public management of trees, in order to provide the city with a high-quality tree population.

At present, Barcelona City Council is responsible for approximately 310,800 individual trees: 201,600 are trees in urban areas (including the trees lining streets and squares), around 35,700 are in municipal parks and gardens, and around 73,500 are in woodland areas. It must be said that the inventory has not yet been completed, and the final figure may therefore be different.

*Albizia julibrissin*

GREATER DIVERSITY OF SPECIES

There are 170 species of public trees in Barcelona. If we add cultivated trees, different varieties and hybrids, this figure is considerably higher, at over 300.

If we consider public areas as a whole, (urban areas and parks) the most representative species is the London plane tree (*Platanus × acerifolia*), an emblematic city tree, with nearly 49,300 individuals, which is 20.8% of the total. Other common trees in the city include the European nettle tree (*Celtis australis*), with 21,870 individuals (9.2%), a tree that adapts very well to urban conditions; the tipuana tipu (*Tipuana tipu*), with 11,500 individuals, (4.8%); and the Japanese pagoda tree (*Styphnolobium japonicum*), with 10,700 individuals, or 4.5% of the total.

In 2012, a project began to balance out the abundance of trees and palm trees in the street, with the aim of ensuring that within 50 years, no species would account for more than 15% of the entire tree population. This would make it possible to avoid risk situations concerning pests and blights that affect a large proportion of the trees, if these were dominated by a single species. It may even make the tree population more resilient to any possible effects of climate change.

1.4.4. Publicly and privately owned trees

Not all the city's public trees are managed by the City Council. Other governmental bodies, such as the Generalitat of Catalonia and Barcelona Provincial Council, also have a number of trees in their facilities in the city. The aim of this Plan is to include these trees in the planning and management guidelines it establishes. There are also privately-owned trees in Barcelona, i.e. individual trees that are located in private estates, plots of land or areas, which may be for public or private use.

Whether they be owned by the municipality, other governmental bodies or privately, it is clearly important to maintain and correctly conserve each individual in the city's tree population and ensure the connection and continuity of its natural heritage. At present, there are no exact figures for the number of trees in private or non-municipal public hands, and an estimated figure is used.

Collaboration between those responsible for the planning and management of the city's roadways, private owners and tree experts is therefore essential for ensuring that trees are planted in all areas of the city and the streets where they can grow as healthily as possible while, at the same time, maximising the functions and services they offer.

The **Master Plan for Barcelona's Trees 2017-2037** highlights the necessary contribution of tree owners and the collaboration between municipal specialists, private organisations and the general public in order to ensure a high-quality tree population for a healthier city.

Barcelona's environmental regulations, approved by Barcelona City Council in 2011, establish that the owners of private green areas and trees, whether they be for public or private use, are responsible for the proper maintenance and conservation of those areas and the trees located within them (Article 7.3:-2).

Regarding conservation actions (Article 7.3-3), it establishes the duty of owners to maintain them in a proper state of conservation and tidiness, carrying out any necessary actions to prevent them becoming a focus for the propagation of invasive species, diseases, or fire risks. Especially in terms of clearing and maintaining hygienic conditions, controlling the phytosanitary condition of plantations, pruning and treating the trees to ensure public safety, and avoiding the introduction of species catalogued as invasive or which are prone to suffering from pests or chronic diseases.

The regulations stipulate that, wherever possible, the technical project for any private green area reform involving the removal or suppression of plants or tree layers, has to include the maintenance of the same number and type of existing plant elements within the territorial boundaries of the reform, along with a preliminary report from Parks and Gardens technical services. This means that any loss of vegetation has to be compensated for. This means that, in both large and small-scale projects where trees may be affected, the owner must follow an operational protocol in order to obtain a building permit. If trees are indeed affected and have to be removed, they will be evaluated using the Standard of Granada.

The owners or operators of woodland areas are obliged to maintain the areas free of undergrowth, and to keep the trees thinned out, their lower branches pruned back, with dry and dead vegetation cleared away, along with any types of waste materials that may propagate a fire, and to remove any trees that are dead or leaning dangerously. Owners of residential areas located less than 500 metres from woodland areas, or that border on other land, have to carry out the conservation tasks established in Act 5/2003, of 22 April. And the owners or operators

of woodland areas and the 500-metre strip of land surrounding them, must comply with the conservation and fire-prevention measures established in Decree 64/1995 of 7 March.

The maintenance of private trees listed as being of local interest, both public and private, is the responsibility of the Municipal Institute of Parks and Gardens, which is also responsible for the maintenance of their identification plaques. The City Council may undertake a monitoring visit at any time, in order to detect possible incidents or actions that need to be carried out.

*La Rambla*

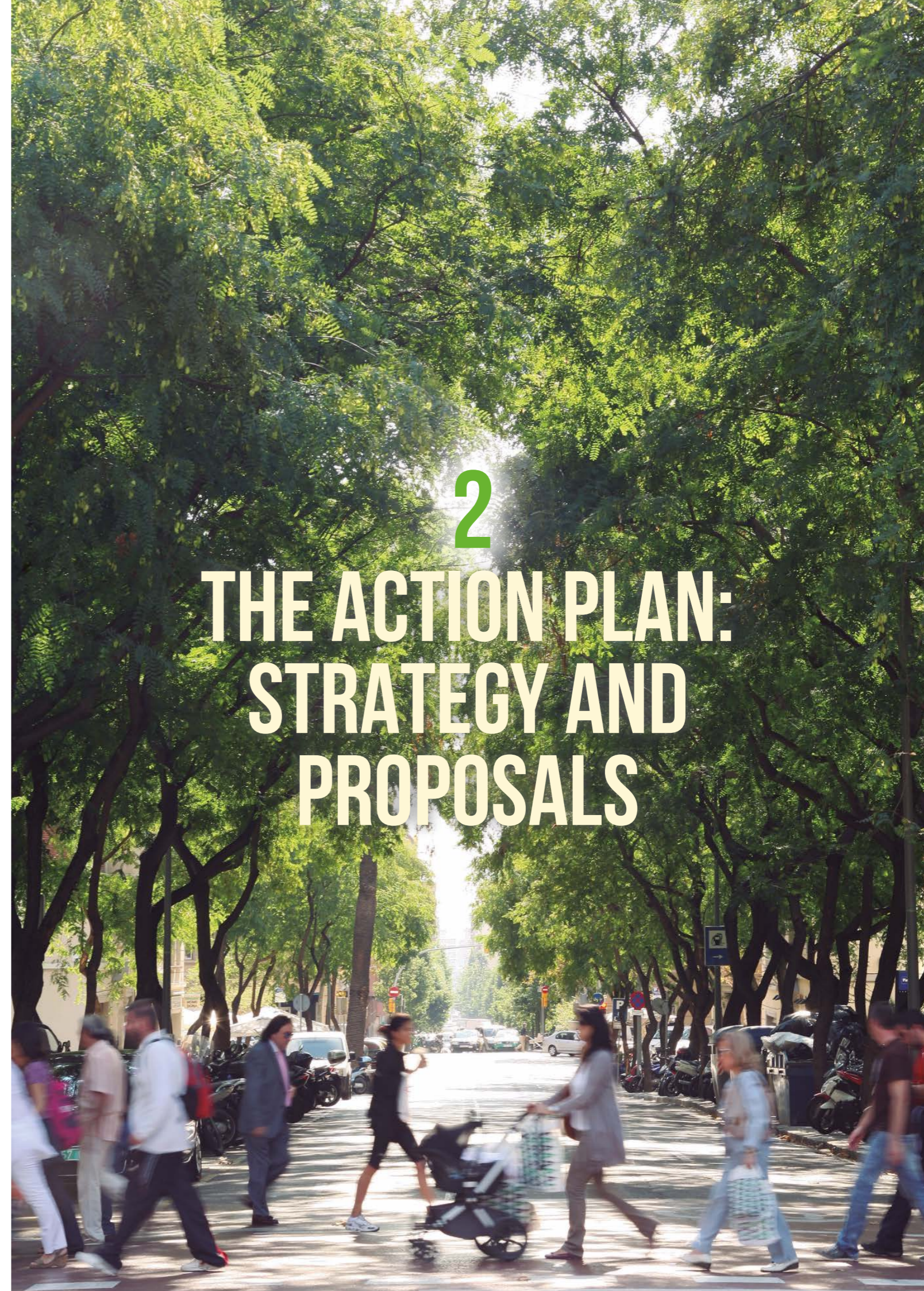
1.5. TECHNOLOGICAL INNOVATION AT THE SERVICE OF URBAN GREEN AREAS

New communication and information tools, along with technological innovation associated with various areas of urban activity and metabolism, provide added value for strengthening the services and functions of infrastructures, including green infrastructure, and making the general public participants in a healthier type of city.

The inclusion of technology as a support tool for the public planning and management of trees, and the entire green infrastructure, has become an essential municipal strategy for building up a more functional, smart network of urban infrastructures.

Examples of actions related to the management of the tree population which can be included in this context are: smart irrigation, with a more efficient consumption of hydrological resources for maintaining plants and structured soils, and high-tech tree wells, which improve the living conditions for root systems.

At present, Barcelona City Council is also working on projects relating to the management of public data, called Open Data and Contactless. These aim to provide the general public with the information held and managed by the public administration. Regarding the tree population, so far the trees present in urban areas and trees of local interest have been published. 🌳



2 THE ACTION PLAN: STRATEGY AND PROPOSALS

2.1. VISION, OBJECTIVES AND CHALLENGES

Barcelona has made its tree heritage an essential value for quality of life in the city, from the social, environmental and landscaping perspectives. Its planning and management by municipal services takes into account aspect such as the selection of species to create a more diverse landscape with greater identity, increasing biodiversity, planning the planting and maintenance of street trees through standardised protocols, progressively introducing biological means of combating pests and diseases, the rational use of irrigation water, the use of new technologies and the introduction of systems for environmental management and health and prevention for workers.

The **Master Plan for Barcelona's Trees 2017-2037** places emphasis on rethinking intervention criteria and processes, with the aim of achieving a more sustainable management and maintenance which improve the living conditions for Barcelona's tree population, thereby maximising the services and functions that healthy trees provide for the city and the well-being of people.

In the new plan, this way of doing things and thinking, in combination with acquired knowledge and know-how, have developed into a more advanced **strategic** vision adapted to modern times.

VISION "Trees that live with the general public and help them to live. Trees are an essential part of Barcelona's green infrastructure, a natural resource that helps the city to have a healthy life and to conserve biodiversity, which connects people to nature, provides the current population and future generations with health and habitability thanks to their environmental, social and landscaping services. The conservation of this green heritage is promoted by the City Council with the involvement of everyone, including the public and private sectors, organisations and the general public".

The Plan identifies trees as a **dynamic, healthy, biodiverse, abundant, mature, safe group of organisms, with more sustainable, iconic native species in parks and gardens**, which must have the best possible conditions for their development, adapted to the urban ecosystem and connected to the city's green infrastructure, so that they can contribute to making the city a healthier place. It recognises the value of trees, or the **tree population**, due to their high ecological value.

The **Master Plan for Barcelona's Trees 2017-2037** establishes **five objectives** which must guide the planning, management and future conservation of Barcelona's trees.



Barcelona as seen from Parc del Putxet

OBJECTIVES

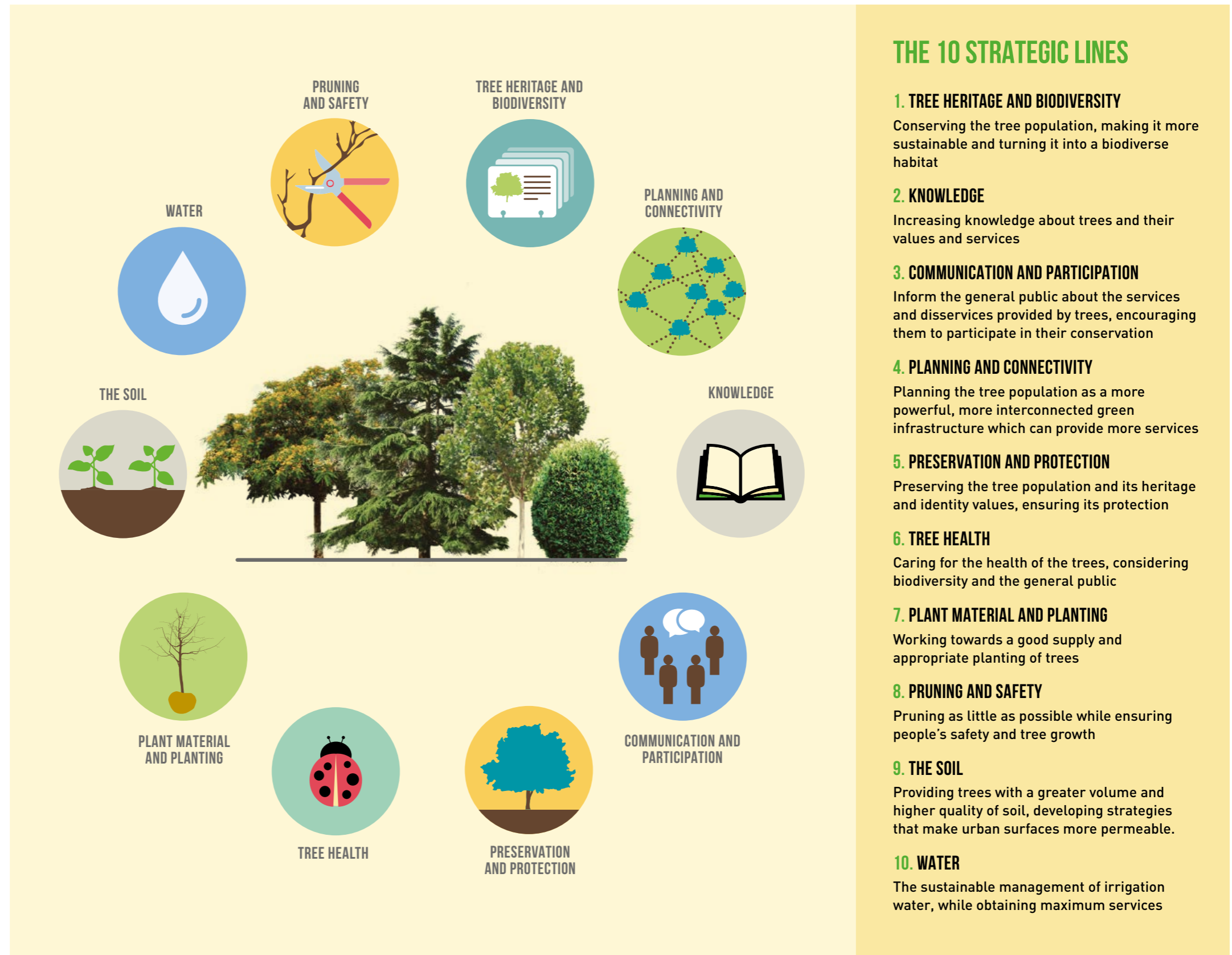
1. Having a tree population that forms a real green infrastructure, achieving the maximum value and connectivity with its surroundings (urban and natural).
2. Getting the maximum environmental, social and economic services from the tree population.
3. Having a tree population that is biodiverse, in good condition, protected, safe and which provides the city with identity, through the most efficient and sustainable management possible.
4. Having a tree population that is adapted, resilient and which can be used as a tool for adapting to climate change.
5. To achieve good coexistence between the general public and trees, and encourage society to value trees more.

The Plan establishes the following as challenges for 2037:

1. Increasing the city's tree cover by 5%, so that 30% of the city's surface area is covered by trees.
2. Ensuring that within urban areas, 40% of tree species are adapted to climate change, as opposed to the current 30%.
3. Achieve a biodiverse tree heritage in which no single tree species accounts for more than 15% of the total population within the urban area.
4. Provide the general public with all the information on the characteristics and services that every tree in urban areas provides, by means of interactive technologies that foster knowledge and citizen collaboration.
5. To ensure that in all Barcelona primary schools, the children appreciate and can identify the trees in their neighbourhood.

2.2. STRATEGIC LINES AND ACTIONS

The proposals of the **Master Plan for Barcelona's Trees 2017-2037** are divided into ten strategic lines, which are put into practice through a range of specific actions. It must be stated that these areas were conceived as a classification that encourages a cross-cutting perspective and synergies. This perspective is extended to the measures proposed in the **Plan for green areas and biodiversity**, given that the two plans are closely interlinked. The strategic lines cover public trees in the streets and in parks and gardens, along with those in private hands.





STRATEGIC LINE 1 TREE HERITAGE AND BIODIVERSITY

Conserving the tree population, making it more sustainable and turning it into a biodiverse habitat

Carrying out a detailed inventory of the city's tree population and studying biological diversity and the fauna it contains, helping to give value to this heritage and strengthen the services and functions it provides for the city and the general public, while also providing the necessary knowledge to act with the greatest technical expertise in the planning, management and maintenance of the tree population.

Action 1.1 – Getting to know Barcelona's tree heritage and producing a complete inventory

Action 1.2 – Balancing out the abundance of all species of trees and palm trees in the city

Action 1.3 – Strengthening the tree population as part of an ecosystem with native fauna and flora.

Action 1.4 – Planning the replacement of trees

STRATEGIC LINE 2 KNOWLEDGE

Increasing knowledge about trees and their values and services

Knowledge provides greater safety and technical rigour during operations. Improving knowledge about trees in general, and each species in particular, makes it possible to plan, manage and maintain the city's tree heritage with more guarantees of success, as well as preparing the tree population and operational procedures for possible future changes in climatic conditions.

Action 2.1 – Studying the tree population's functions, values, services and disservices

Action 2.2 – Assigning an economic value to the benefits of the tree population

Action 2.3 – Studying the effects of climate change on the urban microclimate and its impact on trees

Action 2.4 – Studying how to tackle the scarcity of natural resources in the tree population's management

Action 2.5 – Minimising environmental impact on tree management

Action 2.6 – Improving training for specialist personnel regarding the tree population and fostering ways of collaborating with other municipal departments.

Action 2.7 – Creating knowledge and experience-exchange networks with other national and international cities

Action 2.8 – Seeking and applying new methods for controlling and monitoring the physiological state of trees (infra-red, drones, sensors, etc.)

Action 2.9 – Selecting tree species with an eye to the future (resistance to urban environment, size and shape, flowering)



STRATEGIC LINE 3

COMMUNICATION AND PARTICIPATION

Inform the general public about the services and disservices provided by trees, encouraging them to participate in their conservation

The Master Plan for Barcelona's Trees establishes the importance of an empowered, informed population that is involved in caring for and improving the city's tree heritage. This means sharing with the community the values of trees as living beings, the beneficial services that the tree population provides for the city's habitability and people's health, and everyone's contribution to ensuring a high-quality green infrastructure for future generations. The tools for achieving these goals of community care and informing people about the values of trees include participation forums, environmental education and communication campaigns.

Action 3.1 – Producing and applying a communication strategy for the tree population

Action 3.2 – Promoting educational projects on the tree population in education centres and for the general public

Action 3.3 – Promoting and supporting projects for involving the general public

Action 3.4 – Using new technologies to inform people about the city's tree heritage

STRATEGIC LINE 4

PLANNING AND CONNECTIVITY

Planning the tree population as a more powerful, more interconnected green infrastructure, which can provide more services

Trees form a green infrastructure that extends in a network around the entire city, in a similar way to all the other urban infrastructures and services, although it has other functions. Appropriate planning of this infrastructure, rethinking the way tree-lined streets are constructed and increasing the total number of trees and bushes, contributes to connecting the tree population and helps to maximise environmental and social benefits.

Action 4.1 – Increasing the city's tree body of trees by planting more trees and bushes and improving the quality of existing trees

Action 4.2 – Including the value of the tree population in planning

Action 4.3 – Connecting the tree population with urban and natural environments

Action 4.4 – Reviewing the planning and design criteria for tree planting in city projects

Action 4.5 – Ensuring that each tree species is provided with the best possible agronomic conditions in the urban environment



Liceu metro construction work 1968

STRATEGIC LINE 5

PRESERVATION AND PROTECTION

Preserving the tree population and its heritage and identity values, ensuring its protection

The urban tree population is a cultural heritage with great social, environmental and economic value, due to the services and functions it contributes to the green infrastructure. Even more so when considering historic or iconic trees that have an added value.

Action 5.1 – Producing a plan for preserving iconic tree species in Barcelona

Action 5.2 – Improving and informing the general public about trees of local interest in Barcelona

Action 5.3 – Applying more efficient physical protection systems for trees

Action 5.4 – Ensuring the protection of trees during construction work

Action 5.5 – Reviewing the evaluation and economic compensation criteria for trees and transplanting

Action 5.6 – Organising and reviewing technical and regulatory documents concerning trees and their protection

STRATEGIC LINE 6

TREE HEALTH

Caring for the health of the trees, considering biodiversity and the general public

Trees are living beings, which like all other organisms are susceptible to certain diseases and pests. These can reach serious levels or even cause a tree's death, if their health is not periodically checked. Urban environmental conditions, taking into consideration the future effects of climate change, may lead to the emergence of new pests that demand new treatments, always taking into consideration the legal restrictions concerning the use of certain kinds of products.

Action 6.1 – Applying integrated control of pests and diseases

Action 6.2 – Promoting and informing the general public about the value of beneficial plants, fostering the growth of spontaneous vegetation

Action 6.3 – Seeking alternatives to herbicides for the control of spontaneous vegetation

Action 6.4 – Applying the strategy to combat and control the red palm weevil





STRATEGIC LINE 7 PLANT MATERIAL AND PLANTING

Working towards a good supply and appropriate planting of trees

Keeping trees in good condition is a key factor in ensuring that they integrate properly into the urban environment and are able to resist and adapt to its conditioning factors. Municipal technical criteria and procedures for monitoring and control must be rigorous, as high-quality trees, supplied and planted with the maximum guarantees, are able to offer their maximum potential.

Action 7.1 – Ensuring the long-term supply of trees

Action 7.2 – Purchasing high-quality trees

Action 7.3 – Improving tree planting

Action 7.4 – Rethinking tree nurseries

STRATEGIC LINE 8 PRUNING AND SAFETY

Pruning as little as possible while ensuring people's safety and tree growth

Each tree species has specific characteristics. Allowing trees to grow freely and develop their maximum natural size and shape, while pruning as little as possible, produces high-quality trees that function optimally, while taking into account all safety guarantees for the general public.

Action 8.1 – Reviewing and unifying pruning criteria for trees

Action 8.2 – Pruning young trees to shape them

Action 8.3 – Improving risk evaluation for trees and palm trees

Action 8.4 – Finding new uses for plant residue



STRATEGIC LINE 9 THE SOIL

Providing trees with a greater volume and higher quality of soil, developing strategies that make urban surfaces more permeable.

Apart from being a structural anchor, tree roots are essential for the survival of these living organisms. They capture nutrients and water from the soil that the tree needs to carry out its physiological functions and provide the maximum amount of environmental services. Providing trees with a greater quantity and higher quality of soil encourages root growth and provides the tree with greater quality of life during its entire growth cycle.

Action 9.1 – Trying out and applying new types of soil and permeable surfacing

Action 9.2 – Improving the quality of soil in new plantings

Action 9.3 – Improving soil quality for existing trees

Action 9.4 – Resolving the compatibility between tree wells and accessibility

Action 9.5 – Designing new tree wells and surfacing, rationalising services

STRATEGIC LINE 10 WATER

The sustainable management of irrigation water, while obtaining maximum services

The health and quality of tree body of trees is proportional to the water they receive during their life cycles. Although it is essential to use the city's hydrological resources efficiently, it is also essential to guarantee the frequency and volume of watering that each species requires, as this will allow the trees to maximise their growth and development potential, and therefore the services they provide.

Action 10.1 – Adjusting the amount and frequency of watering to each species

Action 10.2 – Applying the most efficient irrigation technologies

Action 10.3 – Prioritising the use of alternatives to drinking water

Action 10.4 – Making use of run-off water in parks and woodland areas, and also for street trees

Action 10.5 – Seeking appropriate alternative resources for future water availability.



2.3.
OPERATIONAL
SCHEDULE



The Master Plan for Barcelona’s Trees proposes an immediate operational horizon of three years (2017, 2018 and 2019), coinciding with the current term of office, a contiguous five-year period (2020-2025) and a third period until the end of the plan (2026-2037).

The plan has a global, cross-policy perspective that is dynamic and which also depends on many external factors. Annual monitoring of the Plan and a five-year review of objectives, strategies and actions are proposed, in order to adjust the Plan to any changes that may occur. After five years, the results of the strategy’s impact will decide the orientation, priorities and lines of action to be carried out in the successive action plans.

ACTION		2017	2018	2019	2020 - 2025	2026 - 2037
1.1	Getting to know Barcelona’s tree heritage and producing a complete inventory					
1.2	Balancing out the abundance of all species of trees and palm trees in the city					
1.3	Strengthening the tree population as part of an ecosystem with native fauna and flora.					
1.4	Planning the replacement of trees					
2.1	Studying the tree population’s functions, values, services and disservices					
2.2	Assigning an economic value to the benefits of the tree population					
2.3	Studying the effects of climate change on the urban microclimate and its impact on trees					
2.4	Studying how to tackle the scarcity of natural resources in the tree population’s management					
2.5	Minimising the environmental impact of tree management based on pertinent studies					
2.6	Improving training for specialist personnel related to the tree population and fostering ways of collaborating with other municipal departments.					
2.7	Creating knowledge and experience-exchange networks with other national and international cities					
2.8	Seeking and applying new methods for controlling and monitoring the physiological state of trees (infrared, drones, sensors, etc.)					
2.9	Selecting tree species with an eye to the future (resistance to urban environment, size and shape, flowering)					
3.1	Producing and applying a communication strategy for the tree population					
3.2	Promoting educational projects on the tree population in education centres and for the general public					
3.3	Promoting and supporting projects for involving the general public					

ACTION		2017	2018	2019	2020 - 2025	2026 - 2037
3.4	Using new technologies to inform people about the city’s tree heritage					
4.1	Increasing the city’s tree biomass by planting more trees and bushes and improving the quality of existing trees					
4.2	Including the value of the tree population in planning					
4.3	Connecting the tree population with urban and natural environments					
4.4	Reviewing the planning and design criteria for tree planting in city projects					
4.5	Ensuring that each tree species is provided with the best possible agronomic conditions in the urban environment					
5.1	Producing a plan for preserving iconic tree species in Barcelona					
5.2	Improving and informing the general public about trees of local interest in Barcelona					
5.3	Evaluating and putting into practice the most appropriate physical-protection systems on city streets and squares					
5.4	Ensuring the protection of trees during construction work					
5.5	Reviewing the evaluation and economic compensation criteria for trees and transplanting					
5.6	Organising and reviewing technical and regulatory documents concerning trees and their protection					
6.1	Applying integrated control of pests and diseases					
6.2	Promoting and informing the general public about the value of beneficial plants, fostering the growth of spontaneous vegetation					
6.3	Searching for alternatives to herbicides for the control of spontaneous vegetation					
6.4	Applying the strategy to combat and control the red palm weevil					

ACTION		2017	2018	2019	2020 - 2025	2026 - 2037
7.1	Ensuring the long-term supply of trees					
7.2	Ensuring the purchase of high-quality trees					
7.3	Improving tree planting					
7.4	Rethinking tree nurseries					
8.1	Reviewing and unifying pruning criteria for trees					
8.2	Pruning young trees to shape them					
8.3	Improving risk evaluation for trees and palm trees					
8.4	Finding new uses for plant residue					
9.1	Trying out and applying new types of soil and permeable surfacing					
9.2	Improving the quality of soil in new plantings					
9.3	Improving soil quality for existing trees					
9.4	Resolving the compatibility between tree wells and accessibility					
9.5	Designing new tree wells and surfacing, rationalising services					
10.1	Adjusting the amount and frequency of watering to each species					
10.2	Applying the most efficient irrigation technologies					
10.3	Prioritising the use of alternatives to drinking water					
10.4	Making use of run-off water in parks and woodland areas, and also for street trees					
10.5	Seeking appropriate alternative resources for future water availability.					

 Start of the action
 Continuation of the action

2.4. BUDGET AND INVESTMENT

The estimated budget for carrying out the proposals set out in the Master Plan for Barcelona’s Trees 2017-2037 amounts to €9.6 million a year, of which €8.3 million is already available. The other €1.3 million mostly corresponds to investments that must be made in the areas of improving soil and water management.

ESTIMATE OF ANNUAL BUDGET LINKED TO THE MASTER PLAN FOR TREES 2017-2037	
BUDGET ORIGIN	IANNUAL AMOUNT (€)
Chapter 1 (data from 2016)	4.374.869
Chapter 2 (data from 2016)	3.036.880
Annual investment in trees (data from 2015)	900.000
Increase in annual budget for the Plan	1.310.000
Total	9.621.749



Parc de la Barceloneta

The following aspects have been taken into account for the budget estimate:

- **Chapter 1:** the personnel allocated to the tasks of tree maintenance and management. This includes pruning and planting brigades, and the associated legal and administrative resources.
- **Chapter 2:** external contracts that provide maintenance services for trees, such as the application of phytosanitary treatments, removing stumps, etc.
- **Inversions:** corresponding to specific projects for improving the tree population, which were included in the PIM 2011-2015, such as the replacement of individual trees in emblematic streets.

The budgetary distribution by strategic line shows the different percentages for tasks that require more material resources (especially workers), such as Line 8, Pruning and Safety, which requires greater knowledge and networking with other organisations; Lines 2 and 3, Knowledge and Communication and Participation, respectively.

However, in general, it must be said that the budget for the Master Plan for Trees 2017-2037 does not involve a major change in the costs associated with current planning and management tasks, given that they are already well defined, but it does highlight those areas where new investments really need to be made. The strategic lines that clearly need to be prioritised for investment are those concerning the improvement of soil and water management, two key factors for maximising the quality and health of trees, as well as the environmental and social benefits they provide.

An interesting point is that, according to a study by the international organisation The Nature Conservancy entitled “Planting Healthy Air” (2016), Barcelona is a city with a very high return of investment (ROI) in terms of planting trees. In other words, considering the increase in temperature and pollution in the Mediterranean area, and the relatively low cost of planting, the report states that Barcelona’s return of investment is very high in comparison to other European cities.

BUDGET DISTRIBUTION BY STRATEGIC LINES OF THE MASTER PLAN FOR TREES 2017-2037

(INCLUDING THE BUDGET INCREASE REQUESTED FOR THE PLAN)

STRATEGIC LINE	% OF TOTAL
1 – Heritage and biodiversity	4,26%
2 – Knowledge	1,28%
3 – Communication and participation	1,10%
4 – Planning and connectivity	5,33%
5 – Protection and preservation	1,01%
6 – Tree health	12,20%
7 – Plant material and planting	11,48%
8 – Pruning and safety	36,70%
9 – The soil	5,86%
10 – Water	20,78%
	100%

2.5. GOVERNANCE OF THE PLAN

The first draft of the Master Plan for Trees was drawn up by a cross-departmental team made up of specialists from the Department of Green Areas and Biodiversity (DEVB), together with professionals from Urban Planning. Based on this document, a participative process was initiated and carried out in various sessions that have served to share the diagnosis, agree on long-term challenges and objectives and compile contributions and new proposals in order to complete the action plan. All DEVB staff took part, along with other specialists from the Area of Urban Ecology and other City Council areas, experts and professionals from the sector, groups and organisations. A total of **54 sessions were held, with 715 participants.**



Parc de la Ciutadella

Expert tree growers and the Association of nurseries

(5 participants)

Associations APEVC, AEA, AEPJP, Gardening and Landscaping Foundation

(20 participants)

20 organisations from the Council for Sustainability

(45 participants)

Other professionals from the City Council and public institutions: technical licences and public areas, and coordination of district construction work, the Public Health Agency (ASPB), the Zoological Park (BSM), the Urban Ecology Agency (AEU), Barcelona Regional (BR), Barcelona Metropolitan Area (AMB), Barcelona Provincial Council, Collserola Natural Park

(15 participants)

Professionals from 'MASU (DEVB, Water cycle, energy and environmental quality, Cleaning and Waste Management, Planning, Urban Projects, Planning, Mobility and Infrastructures, Communication, Environmental Education, Office of Sustainability, Continual Improvement, Urban Resilience, Public Works Coordination, BIMSA, BAGURSA...)

(81 participants)

PIJIM gardeners

(546 participants)

IN TOTAL 54 SESSIONS HAVE BEEN HELD WITH 715 PARTICIPANTS.

These participative sessions generated a number of proposals, some of which were already part of the plan, others that were later included (some new actions and some new tasks within each action) and others were rejected because they were mutually contradictory or contradicted other widely agreed proposals. During the participative process there were also proposals for organisational improvements, which are also considered within the continual improvement process being employed.

The Master Plan for Trees will have a follow-up system and a set of indicators in order to monitor its objectives. The follow-up system will include periodic evaluation of the degree of compliance with the actions' scheduled time frames, i.e. a system that measures the amount of activity carried out per action. The degree of compliance for each action will be quantified with a percentage that will be determined according to the phases established in the corresponding files.

The participative spirit that prevailed throughout the process of drawing up the strategy is being maintained to ensure good governance. Once it is approved, coordination of the Master Plan for Trees will be the responsibility of the City Council's Department of Green Areas and Biodiversity, through a promoter group that will have to plan the deployment of the plan, coordinating the various players involved, including: gardeners, pruners, specialists in green infrastructure, communication, sustainability strategy and culture, participation, urban planning, health, the Zoo, the Botanical Institute, etc.). 🌱

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