CLIMATE-FRIENDLY PARKS

An adaptive park model to counteract urban heat islands

LIFECITYADAP3

This document was drafted with the financial support of the European Union under the LIFE programme.
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The LIFE CITYAdaP3 project (LIFE19 CCA/ES/001209) was funded
by the EU's LIFE Programme

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Municipality of Reggio Emilia - December 2023

Traslated into English with the support of the University of Murcia

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The four ‘Climate-friendly parks’ have been created as part of the European LIFE CityAdaP3 project.
TIL s.r.l. has supported the initiative through a charitable donation.

The project of the four ‘Climate-friendly parks’, used to define the ‘Climate-friendly parks’ model described herein, can be consulted on the LIFE CITYAdaP3 project webpage of the Reggio Emilia Municipality:
www.comune.re.it/cityadap3

Climate-friendly parks represent the new approach to urban greenery promoted by the Reggio Emilia Municipality which aims at ‘bringing nature back to the city’ in an effort to combat climate change through new design and management solutions.

This approach is a key element in the new strategy of the Reggio Emilia Municipality called Natural Urbanism. This strategy promotes the transition from the traditional paradigm of public green spaces as one of the elements in the urban system, to the idea of a plant component that pervades and permeates the environment making it more pleasant, attractive, and user-friendly.
The project is also an opportunity to implement the founding principles of Reggio Emilia’s Climate Change Adaptation Strategy, which proposes the creation of a truly urban green network as a strategic adaptation objective for our increasingly adaptive and resilient town.

Climate-friendly parks are just the beginning of a new design era for the city’s public spaces. This will increasingly change our habitat and urban landscape: more space for people, more space for nature.

Carlotta Bonvicini
Councillor for Sustainability,
Environment, Agriculture and Sustainable Mobility

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The CityAdaP3

Lead partner: Federation of Municipalities of the Region of Murcia (ES)
Partners: Eurovertice (ES), University of Murcia (ES), Municipalities of Alcantarilla, Lorquì, Molina de Segura (ES), Reggio Emilia (IT)
Duration: September 2020 - October 2024

Between 2020 and 2024, the Municipality of Reggio Emilia has participated -as a partner- in the European project LIFE CITYAdaP3 (LIFE19 CCA/ES/001209) financed under the 'LIFE Climate Change Adaptation' programme.
Six other Spanish partners participated in the project: the Federation of Municipalities of the Region of Murcia (project leader), Eurovertice, the University of Murcia, and the municipalities of Alcantarilla, Lorquì and Molina de Segura.
The main goal of the LIFE CITYAdaP3 project (Financing Cities Adaptation to Climate Change through Public-Private Partnerships and Corporate Social Responsibility) is the implementation of new cooperation models between local authorities and enterprises for the co-development and co-financing of pilot actions for the adaptation to climate change in cities, but also for the incorporation of climate change issues (the necessary adaptation) into the policies of companies within their Corporate Social Responsibility (CSR).

The objectives pursued by LIFE CITYAdaP3 and the key actions implemented are therefore as follows:
- Involving the private sector in the implementation of the Sustainable Energy and Climate Action Plan (SECAP) or Local Adaptation Strategies through a Local Stakeholder Group.
- Defining and signing of Public-Private Partnership (PPP) agreement models.
- Implementing pilot PPP adaptation actions of partner municipalities with local companies.
- Training companies on CSR and climate change.
- Educating schools and citizens on climate change and the importance of adaptation.
- Transferring the acquired knowledge and methodology.

More information on:
www.comune.re.it/cityadap3
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Adaptation Strategy -Vision

"Reggio Emilia, a town where the man-made environment integrates with the natural one; a dense green network - trees, flower beds, gardens, rows of trees, green roofs and walls- that, from the parks and the countryside, fills the whole town, the streets, the sqares, the courtyards, the buildings and the roofs, giving continuity to ecological networks, to reconnect the town with the countryside and mankind with nature"

NATURAL URBAN STRATEGY

An 'urban vegetable environment' bringing nature back to the city, 'contaminating' urban spaces with spontaneous vegetation and the elements typical of our rural landscape

CLIMATE-FRIENDLY PARKS Goals

- Experimenting with adaptive urban forestry interventions in parks
- Mitigating the microclimate of green areas
- Restoring a high degree of nature and biodiversity in parks
- Improving the usability and liveability of parks

Introduction

Given the climate crisis, there is a growing need to radically rethink the role of greenery in cities, greenery that has historically been used mostly as street furniture and often regarded as a 'problem' and an 'expense'.
For some time now, international organisations have been urging governments to increase green standards in cities by adopting the new Natural Based Solution (NBS) approach and experimenting with new urban forestation techniques.
It is in this context that the 'Climate-friendly parks' project was created in Reggio Emilia, co-financed by the LIFE CITYAdaP3 project as the first pilot action towards adaptation.

Within the LIFE CITYAdaP3 framework, partner cities, including Reggio Emilia, were going to implement pilot adaptation actions as of 2021 with the financial co-participation of local companies, stimulating public-private partnerships for projects against climate change.
Specifically in Reggio Emilia, the first pilot action of the LIFE CITYAdaP3 project involved carrying out urban forestation interventions in four of the city's public parks. The aim was to tackle urban heat islands, respond to the sharp increase in heat waves during the summer months, mitigate the microclimate of green areas and improve the way citizens can use them and live in them.
The LIFE CITYAdaP3 project also envisaged afforestation work in areas with different territorial, landscape and social contexts. This would be a key element in the definition of a model-scheme of adaptive park that could be replicated in other areas of the city and proposed at European level, in the improvement of the design of parks and their management in terms of adaptation, environmental and economic sustainability.

This document therefore summarises the design and implementation experience of the first LIFE CITYAdaP3 adaptation pilot action - called 'Climate-friendly parks' - used to define the adaptive park model described herein.

From its beginning, the aim of the 'Climate-friendly parks' project -proposed by Reggio Emilia as a pilot action- was to test its effectiveness in mitigating the microclimate of the green areas affected by the introduction in parks of more natural elements typical of the Po Valley agricultural landscape (hedgerows, permanent meadows, trees rows); secondly, it was to test in Reggio Emilia a new mode of city microforestation (the Miyawaki microforest, named after the Japanese botanist who invented it).

The 'Climate-friendly parks' project (carried out between 2021 and 2022) is therefore the first trial of a new cultural approach to urban greenery whose goal is to 'bring nature back to the city' by combating climate change in four parks located in different territorial contexts in Reggio Emilia: Biagi Park, the green area of Ferravilla streat, Grimaldi Park and Primavera Park.
TIL S.r.l. collaborated in the project by supporting it through a charitable donation.

'Climate-friendly parks' is in line with the Reggio Emilia Climate Change Adaptation Strategy, approved in November 2020, the strategic adaptation objective of which is the creation of a 'green network' in Reggio Emilia.
The project is also part of the recent strategy promoted by Reggio Emilia Municipality for green areas (called Natural Urban) aimed at changing the paradigm from the traditional concept of 'public green areas' as just another element in the urban system, to the idea of a plant component throughout the environment. The expected benefits are manifold and all aimed at re-establishing a more direct relationship with nature: improvement of the microclimate, mitigation of pollution, increase in biodiversity, reduction of maintenance requirements, saving water resources and, finally, the perception of a richer and more pleasant landscape.

Landscape and environmental ‘elements’

01 micro forests

02 hedgerows

03 multi-species meadows

04 rows of trees

05 wetland and semi-wet area

The ‘Climate-friendly parks’ model: the concept

The general idea behind the creation of an adaptive park is based on the desire to test the efficacy of four main landscape-environmental elements to counteract the effects of climate change, both in terms of the mitigation of resulting phenomena (such as heat islands) and the health and resilience of vegetation.

- Microforests (Miyawaki method)
- Hedgerows
- Multi-species meadow
- Rows of trees

The objective is to optimise the combination of the different elements in order to obtain the maximum result in terms of fight against climate change, and also to reinstate a landscape which is sustainable in terms of the complexity of the ecosystem and is enjoyable and inclusive for the population.

The proposed landscape-environmental elements represent a possible evolution of the plants that, in the past, contributed to the formation of the landscape of the Po Valley and which are still partially present in the countryside and peri-urban areas. Their resilience to the weather and other adversities is a starting point for a different approach to the management of urban greenery. By testing, within the framework of this project, their ability to evolve and their environmental relapses, it is possible to plan the reconditioning of the entire territorial system of ecological connections, overcoming the distinction between ‘urban and rural’, in line with the vision and objectives defined in the ‘Climate Change Adaptation Strategy of the Municipality of Reggio Emilia’ and the new policy on natural urban public green spaces.

The definition of elements is based on several methodologies that have been studied for some time in the scientific field and have been validated by concrete experiences that, in Europe and around the world, have been or are being implemented in diverse climatic and environmental contexts (including projects developed by organisations and companies such as Afforestt, Boomforest, Urban-forest, Forestcreators, among others).

In the CITYAdaP3 project, the innovative component of the above-mentioned elements is mainly related to the testing of the effectiveness of associating different plants in order to find out and monitor their resilience to climate change and the impact on indicators that can counteract heat islands through shading and soil regeneration to increase evapotranspiration.

In addition to these four main landscape-environmental elements, a proposal has been made to create a wetland and semi-wet area in Biagi Park by connecting it to a nearby irrigation canal. This additional element would allow to experiment with the introduction in urban areas of a habitat typical of lowland canal banks for the thermo-regulating action of water and to enrich the variety of flora and fauna present.

With regard to the choice of species, European, national and regional indications concerning non-native and potentially invasive species were obviously taken into careful consideration.
However, the experimental nature of the project meant that unconventional choices had to be made. Alongside truly native species, the plan was to include plants coming from climatic zones different from those of the Po Valley; this was done in order to assess how the individual species and the way they are placed together might respond to changing climatic conditions.

01 **NATIVE MICROFOREST**
only native species typical of the lowland forests of the Reggio Emilia plain

ADAPTIVE MICROFOREST **02**
experimental introduction of new species of Mediterranean range (adapted to future climatic conditions)

03 **EDIBLE MICROFOREST**
strong component of fruit plant to complement the vegetation system

“Miyawaki” micro-forests

The first and main landscape-environmental element proposed for the ‘Climate-friendly parks’ project comes from the decision to experiment with the so-called ‘Miyawaki method’ (named after its creator, a Japanese botanist) by creating, for the first time in Reggio Emilia, experimental microforests in urban parks, divided into three types with different combinations of plant species:
• the ‘native’ microforest, made only of native species typical of the lowland forests of the Reggio Emilia area;
• the ‘adaptive’ microforest, with the experimental introduction of new Mediterranean species considered more suitable for future climatic conditions;
• the ‘edible’ forest with a strong component of fruit plants to complement the vegetation system.

The common feature of these types of microforests is based on the fundamental concepts of the Miyawaki method, which can be summarised as follows:
• extremely high planting density (at least 3 young seedlings per square metre) on small plots, no bigger than 200 square metres;
• extremely different species (at least 30) and plant heights included in the forest;
• almost total absence of planned maintenance (pruning, weeding, irrigation systems, etc.).

The Miyawaki method has already proved effective in several areas (even generally arid ones such as Sardinia) where the growth rate of young plants has been found to be ten times higher than the usual forestation techniques used in monoculture models.
Within a few years, the Miyawaki microforest becomes an almost impenetrable structure capable of self-sustaining its evolution and defending itself against external pathogens without any human intervention.

The advantages of this practice, especially in an urban context and with a view to optimising the management of public green spaces, are believed to be potentially considerable both in economic terms (planting young and inexpensive plants, lowering management costs) and in relation to the ‘quick effect’, which is often sought in this type of intervention.

Besides these more pragmatic considerations, it is important to underline the extremely positive effects, widely documented in the literature, that this type of intervention has on the environmental and ecological indicators related to biodiversity and soil health.

Experiments already carried out in other parts of the world have also demonstrated a further potential of the Miyawaki method, i.e. the possibility of citizen involvement in both the planting and the monitoring and care of the new microforests.

01 3 plants/sqm — **Extremely high planting density**

02 > 30 species — **Extreme species differentiation**

03 about 200 sqm — **Very small areas**

04 — **Low or no maintenance**

05 — **Rapid growth**

"Within a few years, the microforest will grow into an almost impenetrable structure capable of self-sustaining its own evolution and defending itself against external pathogens without any human intervention"

ADVANTAGES

FINANCIAL
Inexpensive young plants
lower running costs

"IMMEDIATE EFFECT"

MORE BIODIVERSITY

INTERVENTIONS IN VERY SMALL URBAN AREAS

01 “multispecific” plant structure

02 informal lines

03 irregular planting distances

04 multi-layered vertical development

05 coexistence of shrubs and trees

06 mainly native species

07 low maintenance needs

free growth

biodiversity

ecological corridors

aesthetic & landscape value

Hedgerows

The idea behind this landscape-environmental 'element' is to recover and update the role of hedgerows, one of the features of the agricultural landscape of the Po plains before mechanisation. Generally speaking, and in the Po Valley in particular, hedges have always performed several functions: marking boundaries, acting as a barrier, protection from the wind, supply of fruit and wood, while they also provide food and shelter for the avifauna and a place for the preservation of the entomofauna useful for agricultural crops.

The 'Climate-friendly parks' project sees hedgerows as a 'multi-species' plant structure, i.e. composed of a large number of species, generally mainly shrubs, but also tree and herbaceous elements.

The hedge line is deliberately characterised by a 'non-formal' configuration, in several rows running parallel to each other, with an overall width ranging from 2 to 5 metres.
The planting patterns are also deliberately kept irregular, again with the aim of encouraging free development and increasing their spontaneity.
The vertical development is multi-layered, i.e. with plant crowns touching each other thus giving a distinctive effect of movement, by taking advantage of the different height of said plants, as shrub species that grow at different heights are mixed with tree species.

Hedges designed in this way can, therefore, within the concept of the Climate-friendly parks project, exert a significant influence on the microclimate.
Indeed, the specific shape of their crowns and the morpho-structural characteristics of the different species have a direct effect on the shading produced and an indirect effect on the possibility of regulating wind flow, limiting the evapotranspiration. At the same time, the possible movement of pollutant particles in the atmosphere is reduced, mitigating their negative effects.

On an aesthetic-perceptive level, hedgerows also contribute to make the landscape more pleasant, changing it during different seasons through the chromatic succession of flowering and colouring of the foliage and with the presence of fruit of different shapes and colours.

Hedgerows are also intended to represent a fundamental element from an ecological point of view in relation to their intrinsic capacity to increase biodiversity, representing an indispensable ecological corridor within heavily man-made environments.
Their presence represents a refuge for many species that no longer find suitable places for their reproduction and survival.

01 Typical element of the economy and landscape linked to Parmigiano Reggiano production

02 Meadow enrichment with seeding and mulch

03 Low maintenance requirements (limited mowing)

Landscape and ecological value

Cultural and educational significance

The multi-species meadow

The inclusion in the “Climate-friendly parks” project of this additional environmental landscape ‘element’ is intended to recall an important historical element of the economy and agricultural landscape of the western Emilian plain, linked to the feeding of dairy cattle mainly dedicated to the production of Parmigiano Reggiano. In rural areas, its progressive replacement by mono-species meadows, consisting mainly of alfalfa, has had a strong impact on soil carbon maintenance, biodiversity and has also progressively led to a change in the appearance of the landscape.

A multi-species meadow is a mix of at least five herbaceous species typical of wild meadows. This higher number of species means biodiversity richness.
For the formation of the multi-species meadows, the Climate-friendly parks project created an initial ‘development core’, i.e. an area with a multitude of autochthonous herbaceous species that were not initially present in the existing meadow. The enrichment was carried out partly through the direct sowing of herbaceous species and partly by depositing clippings from selected multi-species meadows.
The aim is to represent the variety of herbaceous species potentially present in the areas of Reggio Emilia and to bring them together. In this context, a situation of natural competition will develop which will regulate the growth of each species, favouring the development of those with greater fitness for survival in specific environments.

As part of the Climate-friendly parks project, the introduction of the multi-species meadows has not only an ecological value, but also a twofold cultural significance: raising awareness of ancient and virtuous cultivation practices, which should be encouraged in agriculture; and educating citizens, who are used to seeing the meadow as a monotonous, undifferentiated backdrop, instead of as an extremely varied ecosystem, fundamental for soil health and biodiversity.

However, managing this design element in a natural way (i.e., limiting human intervention to a very few annual mowings), implies careful communication to the population and informing them, in a correct and comprehensible manner, about the development and evolution of the meadow system, without generating possible misunderstandings regarding the lack of maintenance.

01 shading of public facilities (children's playgrounds and cycle-pedestrian paths)

02 close planting distances to ensure compact shading and to mitigate the microclimate

03 species suitable because of their leaf type, shape and resilience

"The new tree rows are mainly introduced in an adaptive and social way to ensure the protection from solar radiation of the busiest areas, to improve the usability and liveability of the parks even in the summer months"

Tree rows

In the past, tree rows were primarily conceived for main roads as their role was defining their contours, guiding travellers, and shading the way, although they also strengthened the soil and provided wood at the end of their biological life.
Today, the significance of tree rows within an urban context is still largely linked to landscape purposes with the creation of prominent aesthetic elements.

In the Climate-friendly parks project, the new rows of trees are instead planted mainly in an adaptive and social key to ensure shielding from solar radiation of the most frequented areas and to improve the usability and liveability of the parks even in the summer months.
The presence of tall trees, if planted 'tightly', is, in fact, able to significantly improve the microclimate by creating continuous shading which will lower the temperature in summer by several degrees, therefore helping to combat heat islands.
However, tree rows are also important in terms of their benefit against air pollution, thanks to their ability to oxygenate and absorb large amounts of carbon dioxide and to intercept particulate matter, which gets trapped by the leaves.
Thanks to their foliage, they can also act as a barrier to major sources of noise pollution and contribute to the reduction of wind speed by limiting evapotranspiration and thus water loss. The roots, which develop among soil particles, keep the air content optimal, preventing excessive compaction.
Among the individual elements of tree rows, there is also a complex ecosystem that provides shelter for a wide range of living beings in the foliage, woody structures or around the roots.

In the Climate-friendly parks project, the row formation is mainly used to provide more shady spaces in areas where public leisure facilities and cycle-pedestrian routes are concentrated.
The regularity in the planting pattern varies according to which species are selected to create compact shade, while still seeking to give an order and rhythm to the landscape.
In order to meet these objectives, and thus reach the adaptive functions outlined above, it was decided to plant trees larger than the tree species introduced in the hedges and microforests, but at the same time not too big, so that they would be able to root properly.

When choosing the species, attention was also paid to leaf type and crown shape. In order to ensure a significant adaptive effect, shading must in fact be as continuous as possible; choosing suitable species and the right planting distance is therefore an essential aspect.

01 use of irrigation water

02 multiple environments: meadow, banks, wetland and semi-wet areas

03 different species; hydrophytes, hygrophytes, multi-species meadows, trees

04 moving water

thermoregulatory action

biodiversity

multiple environments from meadows to ponds

Wetland and semi-wet areas

In addition to the four main elements mentioned above, which were proposed for the basic model of Climate-friendly parks, a wet and semi-wet area was introduced in one of the parks created in Reggio Emilia as an additional landscape-environmental element to exploit the mitigating action of water on the microclimate in summer.

The northern side of Biagi Park features, in fact, an open irrigation canal managed by Consorzio di Bonifica Emilia Centrale, where water level is rather high in the spring/summer period, while in the remaining part of the year it is only a few tens of centimetres.
The presence of the irrigation canal was immediately considered a relevant opportunity for the extension and enrichment of the area in adaptive terms, which lead to the creation of a wet and semi-wet area.

This additional element will allow to experiment with the introduction in urban areas of a habitat typical of lowland canal banks for the thermo-regulating action of water and to enrich the variety of the flora and fauna. It will therefore be possible to assess its effectiveness in combating heat islands in an urban context.

The wet and semi-wet area created in Biagi Park is divided into two parts. The westernmost sector is a deeper pond with a completely sealed bottom where water is always present. The eastern sector, on the other hand, is a shallow elongated ditch that only receives overflow water from the pond, and can therefore be considered a wetland and semi-wetland area in the strict sense.
The two areas are separated by a septum which guarantees balance between them.
The surface area of the pond is approximately 150 sqm with a maximum depth of 1.2 m with gently sloping sides.
Over the course of the year, the water level is subject to cyclical variations that will change its appearance, affecting the plant composition of the bank area.
The size and type of the structure were conceived to avoid the danger of water stagnation and stratification.

The system proposed as an additional landscape-environmental element therefore creates different habitats, from the meadow to the pond, acquiring qualities typical of transition zones between bodies of water and the terrestrial environment. In nature, these environments are rich in flora, with the potential to host various species of amphibians, birds, etc.

The species in question were selected from those best suited to semi-wet and transitional environments. More specifically aquatic species, submerged plants, periodically submerged bank plants, plants requiring wet soil, and numerous grassy herbaceous species have been included to facilitate colonisation and the establishment of a stable meadow to cover the entire area.

Multi-species meadows

Very little mowing to preserve features

Hedges Trees

Reduced irrigation and only in the first years

Micro forests

No maintenance, only emergency irrigation in extreme cases in the first years

self-regulated

natural

cared for by the citizens

Maintenance

The design outlined for the Climate-friendly parks stipulates that the maintenance of the areas should be limited to the operations that are strictly necessary so that people can use the parks correctly.
The proposed landscape-environmental elements envisage, mostly, a substantial self-regulation of the life of the plants that are part of the scheme; apart from the phases immediately following planting, when they will obviously need assistance to be able the root, the different plants will be able to self-regulate, favouring the flourishing of those species that are more adaptable to the surroundings to the detriment of those that are more water-demanding, or in any case less apt to the environmental conditions.

- In the areas destined for multi-species meadows, mowing will be greatly reduced (approximately 2-3 times per year) to preserve the natural look. It will therefore be possible to appreciate the evolution of the flowering in stages and the development of the species within their life span, taking care to communicate the situation to park uses so that they can understand it.
- The trees in the tree rows and the shrubs-trees forming the hedgerows must, at least in the first three years, receive emergency irrigation in order to ensure their survival in the most difficult periods.
- Maintenance in microforests, on the other hand, must be practically non-existent; in the first few years, they will they receive relief irrigation only in extreme cases of drought. Water limitation is an interesting factor when assessing the resilience of different species, as it makes it possible to discern which plants are best adapted to climate change.

The Climate-friendly parks project can also be an opportunity to test the reliability of the ‘land stewardship’ concept to be applied to an urban park context. With this in mind, the idea is to value collaboration for the conservation of the valuable work that has been carried out, which should also involve cooperation of the public, as users of the areas. This should not involve any specific physical work for the day-to-day management of the heritage, but actions to monitor and care for the conservation of biodiversity and the preservation of the habitat.

"How do we explain to our citizens that the environmental elements in the Climate-friendly parks are meant to reintroduce elements of naturalness in our parks by trying out new solutions to adapt to climate change are not the result of poor design choices and lack of maintenance?"

01 Guided walks in parks with citizens

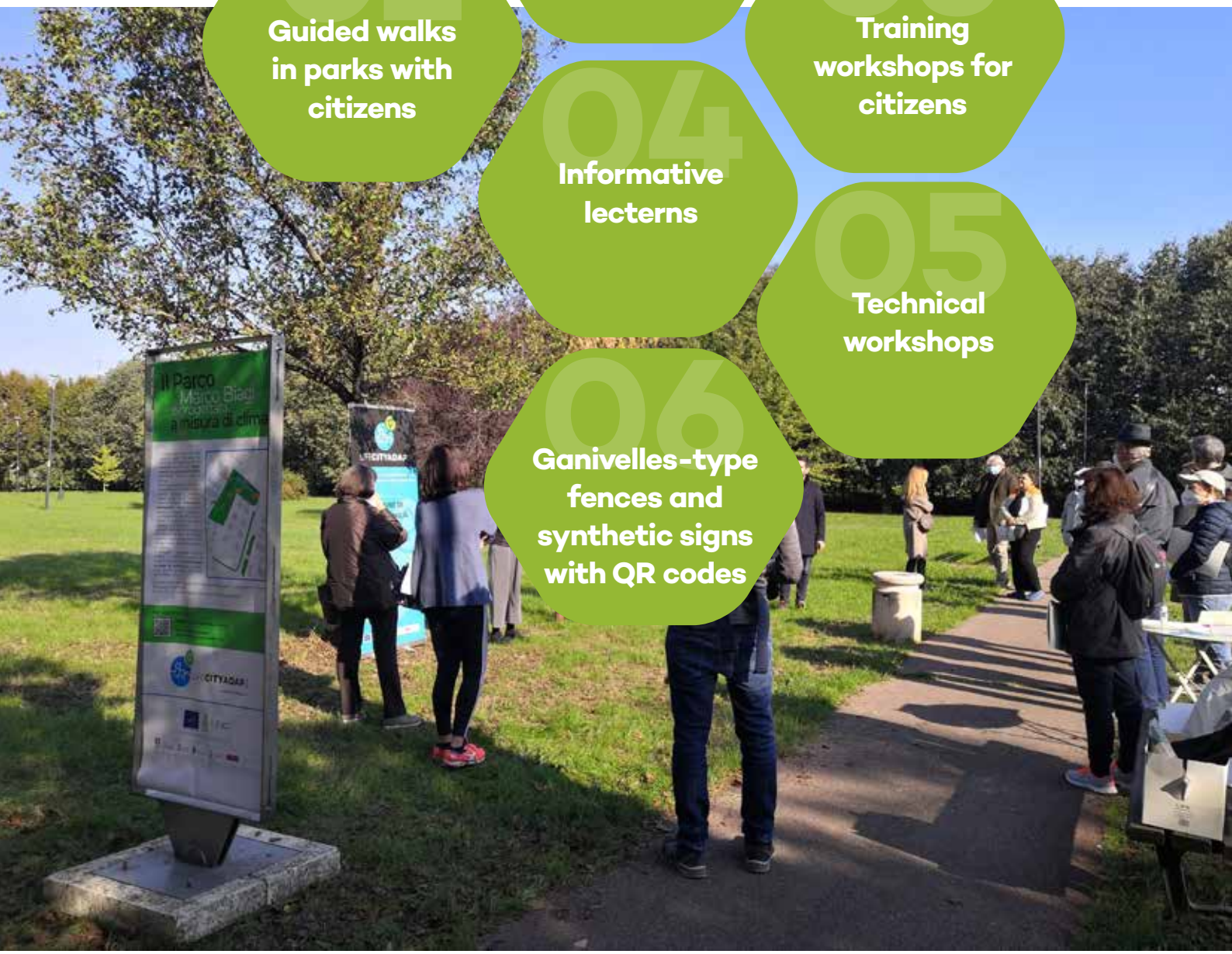
02 Guided tours with schools and universities

03 Training workshops for citizens

04 Informative lecterns

05 Technical workshops

06 Ganivelles-type fences and synthetic signs with QR codes



Communication

The desire to introduce as much natural landscape and environmental elements as possible into the Climate-friendly parks and limiting human interventions, requires ad hoc communication to explain the choices made and the experimental value of the proposals, avoiding in this way possible misunderstandings regarding the low maintenance of the areas.
The communication developed for the four Climate-friendly parks implemented in Reggio Emilia has therefore included different types of actions.

Numerous information and training events were organized for the citizens: guided site visits both during the planning phase and after the project was completed, informative workshops, as well as more academic and technical events and training activities with schools and universities.

In addition, specific traditional information signs (lecterns) were installed in the parks to provide detailed information and the meaning of the new and 'unexpected' elements - the landscape and environmental 'elements' - introduced for the first time in Reggio Emilia, also illustrating their different maintenance requirements.

In addition to classic information signs, visual communication was also experimented with in order to highlight the project's main innovative elements.
While carrying out the project, the fences, which were not initially planned, were actually found to be an important element in highlighting the microforests and multi-species meadows as well as in adequately delimiting the wet and semi-wet area. For this purpose, fences known as 'ganivelles' - very common in Europe - were chosen, consisting of stakes made of debarked and split chestnut wood. They were chosen because of their highly natural features, which make them suitable for this type of project.
Specific user-friendly signage was installed on these fences, with simple messages and a QR code explaining the meaning of the main innovative elements (multi-species meadows, microforests, field hedges, wet and semi-wet area) and the different maintenance involved compared to standard urban parks.

Parchi A MISURA DI CLIMA

Parco Marco Biagi

Il **Parco Marco Biagi** è una delle 4 aree verdi scelte dal Comune di Reggio Emilia per un progetto sperimentale europeo chiamato "Parchi a misura di clima".
Qui sono stati realizzati nel 2022 una serie di interventi di forestazione urbana allo scopo di testare soluzioni capaci di "adattare" i nostri parchi agli effetti del cambiamento climatico, e, in particolare, alle crescenti ondate di calore estivo.
Gli interventi sono stati pensati per contribuire a **migliorare il microclima** (favorendo così la fruizione e vivibilità di questi spazi da parte dei cittadini) attraverso l'ampliamento delle **zone ombreggiate** e l'aumento della massa vegetale, e per elevare i livelli di naturalità e **biodiversità** nei parchi incrementando la presenza di **vegetazione spontanea**.

Il Parco Biagi rappresenta una sorta di laboratorio a cielo aperto, un luogo di sperimentazione per contrastare le isole di calore urbane, un modello di "parco adattativo" tra quelli che, in diverse città europee, si stanno realizzando per ottimizzare la cura del verde pubblico mettendo al centro la sostenibilità e l'adattamento ai cambiamenti climatici.

Questo progetto rientra nella nuova strategia del Comune di Reggio Emilia riguardo al verde pubblico, che ha l'obiettivo di riportare la natura in città creando un "ambiente urbano vegetale" e contaminando gli spazi urbani con vegetazione spontanea ed elementi caratteristici del paesaggio rurale. I benefici sono molteplici: miglioramento del microclima, mitigazione dell'inquinamento, aumento della biodiversità, riduzione delle necessità di manutenzione, risparmio delle risorse idriche e percezione di un paesaggio più ricco e gradevole.

Il progetto **Parchi a misura di clima** è una prima sperimentazione di questo nuovo approccio culturale che si concretizza nell'introduzione di alcuni elementi, più o meno "inaspettati", ricorrenti nelle 4 aree urbane di intervento: la micro-foresta, la siepe campestre, il prato polifita, il filare alberato.

Le micro-foreste sono piccole foreste urbane con una grande densità di piante appartenenti a tante specie diverse, progettate ispirandosi ai concetti del botanico giapponese Akira Miyawaki. Le piante sono lasciate crescere in modo spontaneo per creare una struttura compatta e impenetrabile, un ecosistema che si auto-sostiene senza interventi significativi dell'uomo. La massa vegetale che si verrà a creare con il tempo contribuirà a migliorare il microclima e ad arricchire la biodiversità, aiutandoci a capire quali piante sono più resilienti ai cambiamenti climatici.
Le micro-foreste realizzate sono di tre differenti tipi:
- **la micro-foresta nativa**, composta solo da specie autoctone caratteristiche dei boschi che un tempo ricoprivano la pianura reggiana.
- **la micro-foresta adattativa**, composta dalla combinazione di specie tipicamente autoctone con altre provenienti da zone climatiche più calde e per questo ritenute, in prospettiva, più resistenti alle future condizioni ambientali.
- **la micro-foresta commestibile**, composta in gran parte da alberi e arbusti da frutto combinati con specie forestali autoctone (non presente nel Parco Biagi).

Il prato polifita è un insieme di più colture foraggere presenti sullo stesso terreno che richiama un importante elemento tradizionale del paesaggio agricolo reggiano che si sta progressivamente perdendo. Questo tipo di prato, rispetto ai tradizionali prati di città, si caratterizza per la ricchezza di fioriture spontanee in tutte le stagioni, diventando un grande richiamo per gli impollinatori.
Gli sfalci sono ridotti per consentire la crescita di un ecosistema variegato, fondamentale per la salute del suolo e la biodiversità.

Le siepi campestri, un tempo uno degli elementi caratteristici del paesaggio agricolo, sono composte da un vasto numero di specie a prevalenza arbustiva con la presenza di elementi arborei ed erbacei. Esse rappresentano un serbatoio di biodiversità, in quanto diventano un rifugio per molte specie animali (uccelli, piccoli mammiferi, insetti...) che non trovano più luoghi adatti per la sopravvivenza in città.
Le siepi sono lasciate crescere in modo libero, dando vita a una massa vegetale che contribuisce a migliorare il microclima e crea un ecosistema variegato, rendendo piacevole il paesaggio e arricchendo la biodiversità.

I filari alberati sono impiegati per migliorare l'ombreggiamento delle zone più frequentate fornendo riparo dal calore. I nuovi alberi sono collocati, in particolare, nei punti in cui si concentrano le attrezzature legate allo svago e i percorsi ciclo-pedonali. La distanza tra le alberature, variabile a seconda delle specie individuate, consente di attribuire una "misura", un ritmo ordinatore, al paesaggio del parco.

Nel Parco Biagi, inoltre, è stata creata una **area semi-umida** che sperimenta in ambito urbano l'introduzione di un habitat tipico delle rive dei canali di pianura per sfruttare l'azione termo-regolatrice dell'acqua e arricchire le varietà della flora e della fauna presenti. Il bacino è collegato idraulicamente al vicino canale irriguo di cui costituisce una sorta di estensione naturalistica.
Il suo livello sarà soggetto a variazioni cicliche nel corso dell'anno che ne muteranno l'aspetto influendo sulla composizione vegetale delle sue sponde.

I "Parchi a misura di clima" sono realizzati nell'ambito del progetto europeo LIFE CityAdaP3.
TIL s.r.l. sostiene l'iniziativa attraverso una donazione liberale.

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URBANO

Per saperne di più:
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www.comune.re.it/cambiamenticlimatici
www.lifecityadap3.eu

Prato POLIFITA

+ fiori
+ biodiversità
+ campagna =
– calore

...Impollinatori al lavoro, giardinieri a riposo

Per saperne di più:
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In questa area sperimentale gli sfalci sono ridotti per consentire la crescita di un ecosistema variegato.

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URBANO

Siepi CAMPESTRI

+ colori
+ biodiversità
+ cinguettii =
– calore

...Impollinatori al lavoro, giardinieri a riposo

Per saperne di più:
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In questa area sperimentale le specie arbustive e arboree sono lasciate crescere spontaneamente per creare un ecosistema variegato.

LIFECITYADAP3

URBANO


Micro Foresta
ADATTATIVA
+ verde
+ biodiversità
+ foresta urbana =
– calore
... verde esplosivo, giardinieri a riposo
Per saperne di più:
In quest'area sperimentale le piante sono lasciate crescere in modo spontaneo
per creare una struttura verde compatta e impenetrabile, un ecosistema che si auto-sostiene.
LIFECITYADAP3
URBANO


Area
SEMI-UMIDA
+ blu
+ freschezza
+biodiversità =
– calore
... ranocchie e cicale in concerto
Per saperne di più:
In quest'area sperimentale il livello dell'acqua è soggetto a variazioni cicliche nel corso dell'anno.
LIFECITYADAP3
URBANO


Micro Foresta
COMMESTIBILE
+ verde
+ biodiversità
+ foresta urbana =
– calore
... verde esplosivo, giardinieri a riposo
Per saperne di più:
In quest'area sperimentale le piante sono lasciate crescere in modo spontaneo
per creare una struttura verde compatta e impenetrabile, un ecosistema che si auto-sostiene.
LIFECITYADAP3
URBANO

"Gathering environmental information to assess the effects"

01

Biagi Park Fixed Station

- In the lawn area
- Permanent monitoring
- Temperature, rain, humidity
- Publication of real-time data

02

Biagi Park mobile sensors

- In microforests and tree rows
- Permanente monitoring
- Temperature, humidity
- Periodic publication of data

03

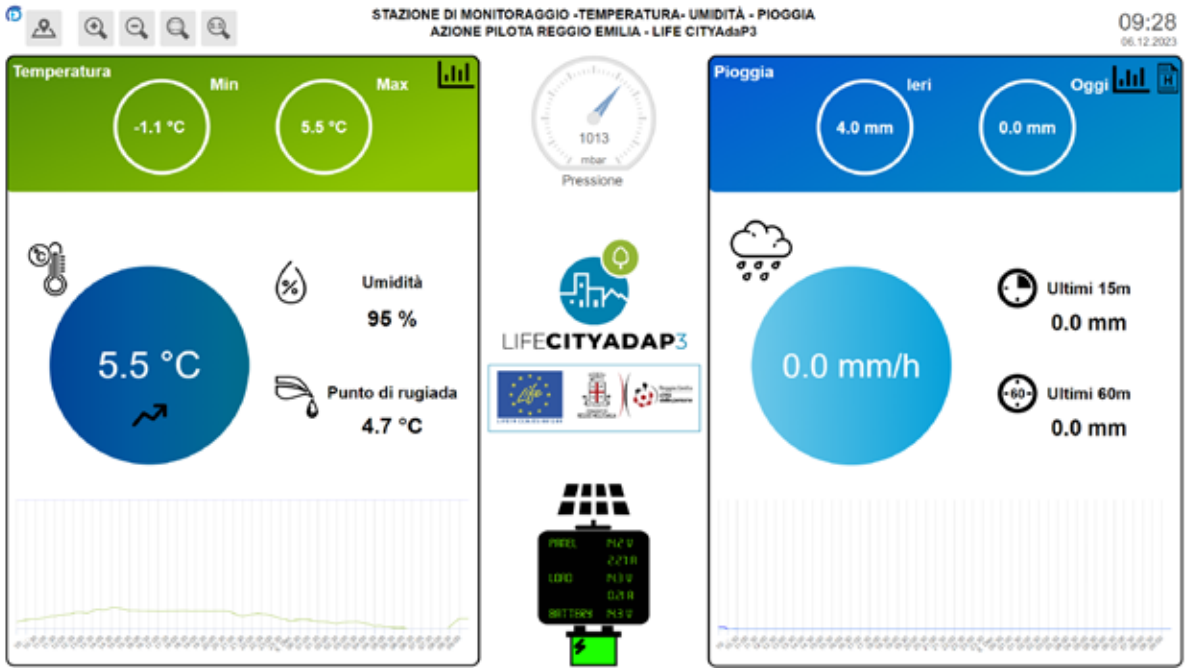
ARPAE control station

- In the old town
- Permanente monitoring
- Temperature, rain, humidity

Monitoring

One of the requirements of the LIFE CITYAdaP3 project was monitoring through sensors the intervention areas of the pilot actions, with the aim of gathering information to continuously evaluate the adaptive effects of the pilot action itself.
In Reggio Emilia, as part of the Climate-friendly parks project, Biagi Park was selected as the park to be monitored, as it is the area where the adaptive park model is applied and tested most comprehensively.

A fixed weather station, powered by a photovoltaic panel, has been installed in an open lawn area of Biagi Park. It continuously records the main weather and climate data: temperature, humidity, and rain.
The monitoring activity is managed by “Consorzio di Bonifica dell’Emilia Centrale”, which already has a similar network in Reggio Emilia territory and in-depth knowledge of weather station management.
The information collected is published in real time on the web and can also be freely consulted/downloaded in time series: http://cbec.ectoss.com:88/?display=Parco%20Biagi



Alongside these fixed sensors, battery-powered mobile sensors have also been placed both within a microforest and near a tree row to provide data that will be periodically uploaded to the web platform.
These data will supplement those measured by the weather station and will be useful for assessing the differences in temperature and humidity between the fixed station (located in open grassland) and the microclimate within a microforest and the shaded area of a tree row.

Periodically, the data are analysed and compared with those of a similar ARPAE weather station set in a highly constructed areas in order to assess the benefits that green elements generate on the microclimate.
The choice fell on the station located on the roof of the Reggio Emilia Townhall in Emilia San Pietro streat, in the old town, where the urbanisation level is high.

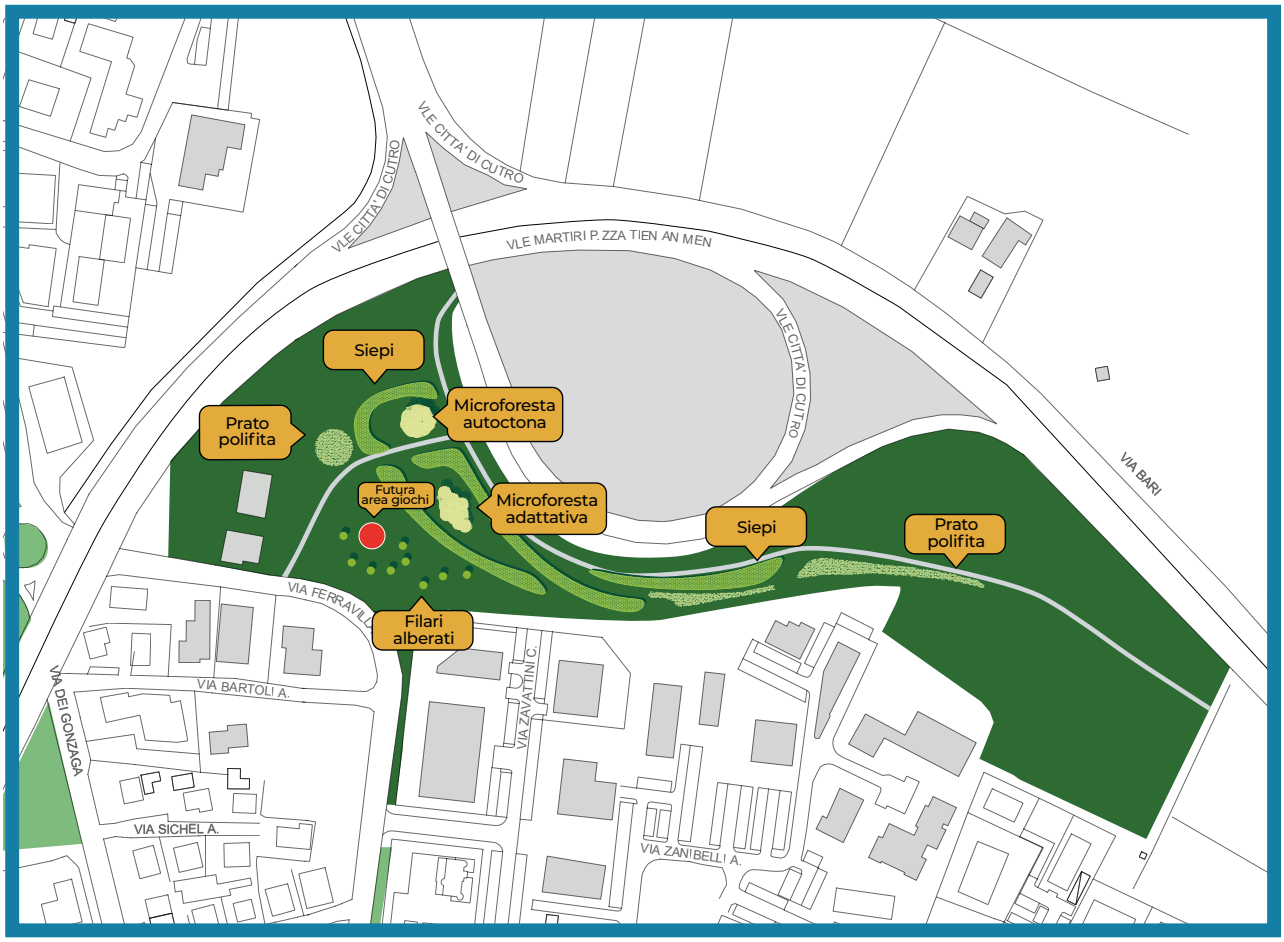
01 Biagi Park

Biagi Park: an example of an adaptive park

Of the four green areas subject to adaptive intervention, the project concerning Biagi Park was developed with particular attention, as it was intended to be the pilot scheme. In fact, the project represents a proposal for the creation of an 'adaptive park' that may represent, more than others, a model to be followed for the creation of similar areas in urban contexts, even potentially different ones.
It is where all the landscape and environmental elements are condensed, placed here according to the nature of the area and the trees already present, again following the adaptive concept.
Also, the presence on the northern border of the irrigation canal was a relevant opportunity for the extension and enrichment of the area in adaptive terms with the creation of a wet and semi-wet area. The project was financed by the municipal administration as an additional 'element'.
Wet and semi-wet areas constitute one of the richest habitats for biodiversity, and it will also be very interesting to be able to assess their function in an urban context to counter heat islands, thanks to the natural thermoregulatory action of water.
The microforests created in the eastern area in Biagi Park are of two types: a 'native' micro-forest and an 'adaptive' micro-forest. Instead, the 'edible' microforest was only introduced in Grimaldi Parkin Codemondo urban area.
The Biagi Park project also included the creation of a linear tree row, partially mirroring an existing one, made of the same type of plant (Tilia platyphillus). This double row will provide better and increased shade on the existing cycle and footpath. Similarly, additional trees were planted near the children's playground and bench area, which was not adequately shaded.
The work was completed with a large multi-species hedgerow in the western area, which also serves as a visual protection barrier against the adjacent craft area. The new hedge is a continuation of pre-existing shrub elements, complementing and enhancing their purpose.
Here, too, the hedgerow was created by combining different species with a predominance of shrubs, but with a tree component that achieves the landscape effect and meets the ecological and environmental purposes.
In the south-western area, as a continuation of the hedgerows and adjacent to the children's play area, a small multi-species meadow was also created. A similar multi-species meadow also surrounds the wet and semi-wet area.
The multi-species meadow area and the microforests are suitably delimited with a natural fence (ganivelles) and clearly and easily identified with appropriate signage. The aim is, on the one hand, to avoid any inappropriate maintenance work, and, on the other hand, to clarify the actual objective of the project to the population.
A fence with ganivelles also surrounds the wet and semi-wet area with the same objectives, as well as being used for the necessary safety signs.

To fully illustrate the project, the plans of the other three Climate-friendly parks implemented in Reggio Emilia as part of the LIFE CITYAdaP3 project are also shown in the following pages.

02 Grimaldi Park

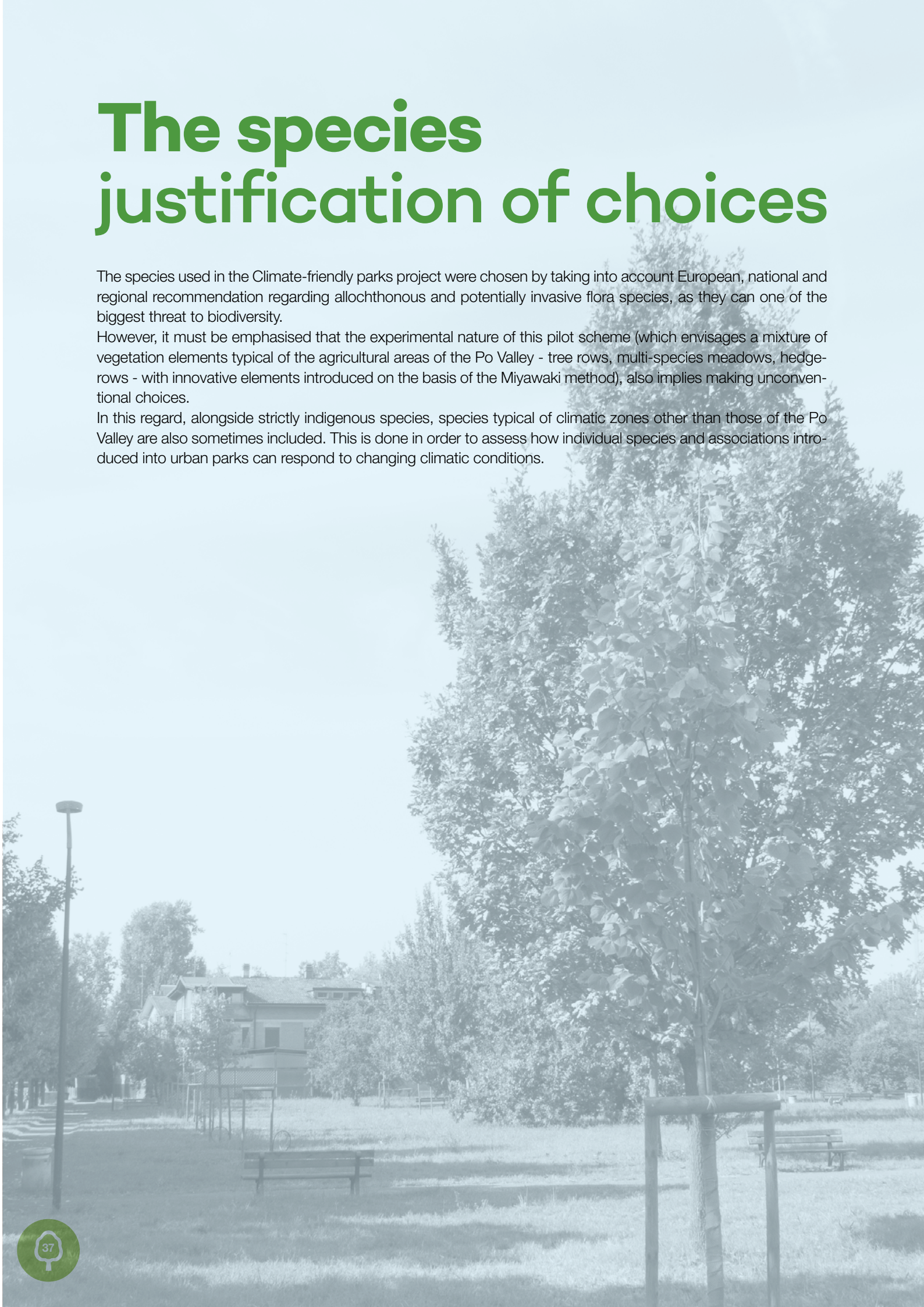


03 Grean area in Ferravilla streat

04 Primavera Park

The species justification of choices

The species used in the Climate-friendly parks project were chosen by taking into account European, national and regional recommendation regarding allochthonous and potentially invasive flora species, as they can one of the biggest threat to biodiversity.
However, it must be emphasised that the experimental nature of this pilot scheme (which envisages a mixture of vegetation elements typical of the agricultural areas of the Po Valley - tree rows, multi-species meadows, hedgerows - with innovative elements introduced on the basis of the Miyawaki method), also implies making unconventional choices.
In this regard, alongside strictly indigenous species, species typical of climatic zones other than those of the Po Valley are also sometimes included. This is done in order to assess how individual species and associations introduced into urban parks can respond to changing climatic conditions.



TREES ROWS - SPECIES

Scientific name	Common name
Acer campestre	Field maple
Acer platanoides	Norway maple
Alnus glutinosa	Alder
Carpinus betulus	Hornbeam
Celtis australis	Nettle tree
Fraxinus excelsior	European ash
Fraxinus angustifolia	Narrow-leaved ash
Malus sylvestris	Crab apple
Populus alba	White poplar
Populus nigra	Black poplar
Prunus avium	Wild cherry
Pyrus pyraster	Wild pear
Quercus cerris	Turkey oak
Quercus pubescens	Downy oak
Quercus robur	Pedunculate oak
Salix alba	White willow
Sorbus torminalis	Wild service tree
Tilia sp.	Lime tree
Ulmus minor	Field elm

The species trees

The tree species that make up the rows or clusters of trees were chosen by taking into account the context (characteristics of the sites and pre-existing trees) but also the need, where possible, to choose types that are better able to withstand the increase in temperature, the intense summer heat waves and the increasing frequency of drought periods.
To this aim, attention was paid to the leaf type and shape of the foliage, in order to ensure as good shading as possible and a significant effect in adaptive terms.
The choice always fell on species that are indigenous, not very water-demanding whenever possible and potentially well adapted to the urban environment.
Their placement also follows adaptive criteria; the aim was to create shaded areas in the most heavily used areas for pedestrian/cycle traffic and for parking and play areas, where present.
It should be emphasised that the fruit trees introduced in the small, wooded area created in Primavera Park (which do not have particularly shady canopies) are indigenous species present in the lowland woods and are included here for educational purposes for schools.

- evaluation of the existing context
- indigenous species only
- adaptive capacity: foliage shape and leaf type
- tolerance to pathophysiological problems
- absence of specific undesirable features
- ability to capture CO_2 and particulate matter

HEDGEROWS - SPECIES

Scientific name	Common name
Arboreal component	
Amelanchier	Shadbush
Arbutus unedo	Strawberry tree
Hippopae ramnoides	Sea buckthorn
Laburnum anagyroides	Laburnum
Prunus pado	Bird cherry
Prunus spinosa	Blackthorn
Rhamnus cathartica	Common buckthorn
Salix cinerea	Grey willow
Shrub component	
Berberis vulgaris	Barberry
Cornus mas	Cornel
Cornus sanguinea	Common dogwood
Corylus avellana	Hazel
Cotinus coccygria	Smoketree
Cotoneaster spp	Cotoneaster
Cytisus scoparius	Common broom
Euonymus europaeus	European spindletree
Frangula alnus	Alder buckthorn
Ligustrum vulgare	Common privet
Lonicera	Honeysuckle
Pyracantha coccinea	Scarlet firethorn
Rosa canina	Rosehip
Sambucus nigra	Black elder
Spartium junceum	Spanish broom
Syringa vulgaris	Common lilac
Viburnum lantana	Wayfaring tree
Viburnum opulus	Guelder rose
Viburnum tinus	Laurustinus

The species hedgerows

The trees and shrubs for the hedgerows were selected by favouring predominantly native species and in accordance with the adaptive objectives pursued in the project.
Many different species were utilised, placed in double rows to increase biodiversity and to ensure better plant coverage.
The decision to mix different shrub species was also based on the desire to create an irregular, multi-layered vertical development, with canopies that interpenetrate by taking advantage of the different heights of the plants, thanks to the coexistence of species with different height development, but also foliage colouring and different flowering times.

- multi-species
- tree and shrub species
- multi-layered vertical development
- mainly indigenous species
- aesthetic-formal considerations: foliage colouring, flowering, fruit
- ability to adapt
- tolerance to endemic pathophysiological problems
- absence of specific undesirable features

NATIVE MICROFOREST (INDIGENOUS) - SPECIES

Scientific name	Common name
Arboreal component	
Fraxinus excelsior	European ash
Populus alba	White poplar
Populus nigra	Black poplar
Prunus avium	Wild cherry
Quercus cerris	Turkey oak
Quercus petraea	Downy oak
Quercus robur	Pedunculate oak
Tilia cordata	Small-leaved lime
Tilia platyphyllos	Large-leaved lime
Ulmus minor	Field elm
Acer campestre	Field maple
Carpinus betulus	Hornbeam
Fraxinus ornus	Manna ash
Laurus nobilis	Bay tree
Malus sylvestris	Crab apple
Morus sp.	Mulberry tree
Pyrus pyraster	Wild pear
Sorbus torminalis	Wild service tree
Shrub component	
Berberis vulgaris	Barberry
Cornus mas	Cornel
Cornus sanguinea	Common dogwood
Corylus avellana	Hazel
Cytisus scoparius	Common broom
Euonymus europaeus	European spindletree
Frangola alnus	Alder buckthorn
Ligustrum vulgare	Common privet
Prunus spinosa	Blackthorn
Rhamnus cathartica	Common buckthorn
Rosa canina	Rosehip
Sambucus nigra	Elder
Viburnus opolus	Guelder rose

The species indigenous microforests

In the choice of the tree and shrub species that make up the ‘native microforest’, native tree and shrub species of various sizes were selected, favouring those typical of the Po Valley.
These species, apart from being an example of lowland vegetation, adapt generally well to the physical and biological conditions of the soil and to climatic conditions of the geographical area of reference, have low demands and are able to spread easily to surrounding areas.
The number of species is very high following the Miyawaki methodology.

- high number of different species
- only indigenous species typical of lowland vegetation
- tree and shrub species
- resistance to pollutants and pathogens and plant pests

ADAPTIVE MICROFORESTS SPECIES

Scientific name	Common name
Arboreal component	
Acer monspessulanum	Montpellier Maple
Celtis australis	Nettle tree
Cercis siliquastrum	Judas tree
Fraxinus excelsior	European ash
Quercus frainetto	Common oak
Salix alba	White willow
Alnus glutinosa	Alder
Fraxinus oxycarpa	Narrow-leaved ash
Laurus nobilis	Bay tree
Ostrya carpinifolia	Hop-hornbeam
Quercus ilex	Holm oak
Quercus suber	Cork oak
Sorbus aucuparia	Mountain Ash or Rowan
Shrub component	
Amelanchier	Shadbush
Arbutus unedo	Strawberry tree
Cotinus coggygria	Smoke bush
Cotoneaster spp	Cotoneaster
Hippopae ramnoides	Sea buckthorn
Laburnum anagyroides	Laburnum
Salix cinerea	Grey willow
Sambucus nigra	Black elder
Spartium junceum	Spanish broom
Viburnum lantana	Wayfaring tree
Viburnum tinus	Laurustinus

The species adaptive microforests

In the adaptive microforests, the numerous native species are combined with a wide selection of species from typically Mediterranean ranges, scrubland and/or arid meadows, which are generally resistant to long hot and dry summers, in order to assess their possible adaptation to changing climatic conditions.
To be highlighted here is the inclusion of some evergreen species (e.g., holm oaks) from the Mediterranean area, which respond well to the need for continuous capture of airborne particulate matter.

- high number of different species
- native species mixed with Mediterranean species
- tree and shrub species
- presence of evergreen species
- resistance to pollutants and pathogens and plant pests

EDIBLE MICROFOREST (FOOD FOREST) - SPECIES

Scientific name	Common name
Fruit plants	
Arbutus unedo	Strawberry tree
Berberis vulgaris	Barberry
Cornus mas	Cornelian cherry
Cydonia oblonga	Quince
Diospyros kaki	Persimmon
Eleagnus sp.	Thorny elaeagnus or silverthorn
Eriobotrya Japonica	Japanese Medlar
Ficus carica	Fig
Malus sp	Apple tree
Mespilus germanica	Medlar tree
Morus sp.	Mulberry tree
Prunus amygdalus	Almond tree
Prunus armeniaca	Apricot tree
Prunus avium	Armoracia cherry
Prunus cerasifera	Cherry Plum
Prunus cerasus	Black cherry
Prunus domestica	Plum
Prunus persica	Peach tree
Punica granatum	Pomegranate
Pyrus sp	Pear tree
Ribes uva spina	Ribes
Rosa canina	Rosehip
Rubus idaeus	Raspberry
Rubus sp	Garden blackberries
Sambucus nigra	Elder
Sorbus sp.	Rowan
Vitis vinifera	Grapevine
Ziziphus jujuba	Chinese date

EDIBLE MICROFOREST (FOOD FOREST) - SPECIES

Scientific name	Common name
Trees and shrubs	
Acer campestre	Field maple
Alnus glutinosa	Alder
Carpinus betulus	Hornbeam
Celtis australis	Nettle tree
Cercis siliquastrum	Judas tree
Coronilla emerus	Scorpion senna
Corylus avellana	Hazel
Fraxinus excelsior	European ash
Fraxinus ornus	Manna ash
Hippophae rhamnoides	Sea buckthorn
Quercus robur	Pedunculate oak
Ceratonia siliqua	Carob tree
Salix sp	Willow
Spartium junceum	Spanish broom
Tilia sp	Lime tree
Ulmus campestre	Field elm
Herbaceous plants	
Achillea millefolium	Yarrow
Armoracia rusticana	Horseradish
Artemisia absinthium	Wormwood
Bellis perennis	English daisy
Beta vulgaris	Beet
Beta vulgaris	Beet
Borago officinalis	Starflower
Brassica sp	Field mustard
Calendula sp	Calendula
Capsella bursa-pastoris	Shepherd's purse
Cichorium intybus	Chicory
Dacus carota	Wild carrot
Foeniculum vulgare	Fennel
Fragaria vesca	Strawberry
Humulus lupulus	Hops
Lamium purpureum	False nettle
Levisticum officinale	Lovage
Lupinus sp	Lupin
Melissa officinalis	Melissa
Mentha species	Mint
Plantago lanceolata	Plantain
Portulaca oleracea	Purslane
Primula sp	Primula
Rheum sp	Rhubarb
Stellaria	Chickweed
Symphytum officinale	Comfrey
Taraxacum officinale	Dandelion
Tragopogon pratensis	Goat's-beard
Tropaeolum majus	Nasturtium
Tussilago farfara	Coltsfoot
Urtica dioica	Nettle
Valeriana officinalis	Valerian
Valerianella locusta	Cornsalad
Vicia faba	Broad bean
Viola sp	Violet

The species edible microforests

In the edible microforest, only available in Grimaldi Park, a large number of fruit tree species are used alongside native tree and shrub species that also produce small fruit (plum, apricot, fig, pomegranate, apple, pear, blackberry, elderberry, etc.). There are also numerous herbaceous species, which, especially in the first phase of the establishment of the food forest, will be essential to ensure the proper formation of a substrate rich in organic components.

- high number of different species
- indigenous species together with fruit trees and shrubs
- tree, shrub, and herbaceous species
- resistance to pollutants and pathogens and plant pests

WET AND SEMI-WET AREA - SPECIES

Scientific name	Common name
Trees	
Alnus glutinosa	Alder
Salix alba	White willow
Ulmus minor	Elm
Herbaceous plants	
Achillea millefolium	Yarrow
Bellis perennis	English daisy
Borago officinalis	Starflower
Calendula arvensis	Calendula
Callitriche palustris	Vernal water-starwort
Carex pendula	Pendulous Sedge
Carex acutiformis	Lesser Pond-sedge
Cichorium intybus	Chicory
Daucus carota	Wild carrot
Foeniculum vulgare	Fennel
Fragaria vesca	Strawberry
Iris pseudacorus	Water iris
Jacobaea paludosa	Senecio
Lamium purpureum	False nettle
Lemna minor	Common duckweed
Leucojum aestivum	Summer Snowflake
Lythrum salicaria	Purple loosestrife
Melissa officinalis	Melissa
Mentha aquatica	Water mint
Nasturtium officinale	Watercress
Nymphaea alba	White water lily
Nuphar lutea	Yellow water lily
Primula veris	Primrose
Ranunculus ficaria	Buttercup
Stellaria aquatica	Chickweed
Symphytum officinale	Comfrey
Taraxacum officinale	Dandelion
Thalictrum flavum	Meadow rue
Typha minima	Miniature bulrush
Tragopogon pratensis	Goatsbeard
Tussilago farfara	Coltsfoot
Valeriana officinalis	Garden valerian
Valerianella locusta	Cornsalad
Viola odorata	Sweet violet
Viola elatior	Shrubby violet

The species wet and semi-wet area

The species for the wet and semi-wet areas were selected from those most suited to natural humid and semi-humid environments, in line with the experimental objectives of the project and taking into account European, national, and regional directives regarding invasive species.
In particular, hydrophytic and hygrophytic species and some meadow species (all native) were introduced to increase plant biodiversity. More specifically aquatic species (submerged plants -floating or rooting in water), wetland plants, plants from periodically submerged banks, plants requiring permanently wet soil, and numerous grassy herbaceous species have been included to facilitate colonisation and the establishment of the area.

The trees (willow and alder) planted along the bank of the pond are typical of wetlands. In addition, two elm specimens (reproduced in the Modena Botanical Garden from seed from a noble tree - the Campagnola elm) were planted in the adjacent multi-species meadow, which will shade the pond.

- hydrophytic and hygrophytic species
- indigenous meadow species
- characteristic bank species

LIFECITYADAP3

Climate-friendly parks

An adaptive park model to counteract urban heat islands