

Welcome to the Urban Biodiversity Office!

An Urban Biodiversity Guidebook for cities to transform their relationship with nature



*A mosaic landscape in an award-winning public park (Pünkösfürdő, Budapest)
© Ferenc Albert Szigeti*

Network Result Product of the BiodiverCity URBACT network: community-based approaches to foster urban biodiversity and nature-based solutions



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Prepared by:

Ferenc Albert Szigeti, coordinator of the Hungarian Hub for Nature-based Solutions, lead expert of the BiodiverCity network

Contributors:

Elena Dionori, naturalist, environment educator and butterfly expert, collaborator at Museo di Storia Naturale Accademia dei Fisiocritici, Siena: Bioblitz: an engagement tool directly focusing on urban biodiversity

Dr. Ildikó Réka Báthoryné Nagy, associate professor, Hungarian University of Agriculture and Life Sciences, national coordinator of the URBACT program: Wildflower meadows in the city / Climate-adaptive grassland management in urban environments; There is no biodiversity without vital habitats that attract species

Marieke Muilwijk, independent advisor on urban planning and cultural heritage for resilient landscapes, ad-hoc expert of the BiodiverCity network: Nature-inclusive buildings / When the dense urban fabric yet has lots of free space for greening

Designed by: Beáta Ferenczi

With the contribution of all the great colleagues and stakeholders from Cieza (ES), Dunaújváros (HU), Guimarães (PT), Limerick (IE), Poljčane (SI), Sarajevo (BIH), 's-Hertogenbosch (NL), Siena (IT), Veszprém (HU) and Vratsa (BG)

Contact: ferenc.szigeti@burstgroup.eu

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*Study visit in Limerick
© Limerick City and County Council*



What is beauty? Climate adaptive grassland management in Veszprém
© VKSZ Zrt., Veszprém

Urban biodiversity vs. nature-based solutions

From microscopic fungi to rainforests, biodiversity is the incredible variety of organisms that work together in ecosystems to maintain balance and support life. Ecosystems are biological communities of interacting organisms and their physical environment. Biodiversity supports everything in nature that is essential to survival: food, clean water, medicine, clothing, climate, and economic growth. According to the [World Bank](#), over half of the global GDP is directly dependent on nature.

The term ‘urban biodiversity’ refers to the variety of living organisms and the multiplicity of habitats in and around (dense) human settlements. Although nature is often more diverse outside of cities, many factors make urban biodiversity important, and cities have a unique role in this story.

Perhaps it sounds strange, at least at first sight, but urban areas might harbour a high diversity of species. Urban landscapes can be, for instance, especially valuable for pollinators and shelter a relatively high pollinator diversity compared to monoculture-dominated agricultural landscapes due to the high variety, availability, and temporarily even distribution of floral resources. Therefore, conservation within urban areas is directly essential for many species.

Second, cities offer unique opportunities for learning and education about a resilient and sustainable future and have a significant potential to boost innovations and governance tools. However, improving protected areas within urban areas and making existing green spaces biodiversity-inclusive is not only important for the species themselves, but also for us, the growing number of city dwellers. And municipalities, as most local forms of government, have a special role to play.

Third, billions of urban dwellers are at high or extreme risk of environmental disaster; thus, urban green spaces are beneficial for residents for multiple reasons through the ecosystem services green areas provide. Through provisioning services such as providing timber, fruits, or honey; ‘essential-to-life’ supporting (nutrient cycles, soil development, photosynthesis, water circle) and regulating services (evaporation, absorption of pollution, cleaning water, carbon sequestration) to more “soft” cultural services (recreation, landscape, environmental education, research, art), nature is our best ally in combating climate change and enhancing the adaptive capacity of cities. The so-called nature-based solutions (NbS) are essential at this point.

The problem is that because we have dramatically lost our connection to nature, we still prefer unsustainable and biologically poor, manicured mown (almost) everywhere in Europe. We do not know the difference between a primeval forest and a tree plantation, we do not understand the importance of wetlands and peatlands in carbon sequestration, and we do not realise how forests create rain. Therefore, we need to reestablish our connection with nature, especially in Europe, where 81% of EU protected habitats and 63% of EU protected species are in “poor” or “bad” conservation status ([2020 ‘State of Nature in the EU’ report](#)). As the EU Biodiversity Strategy 2030 says, Europe’s protected habitats and species continue to decline at an alarming rate because the multiple pressures they face are simply too tremendous to enable their recovery. In line with the global goals, the strategy aims to stop and reverse this trend by promoting the systematic integration of healthy ecosystems, green infrastructure and nature-based solutions into all forms of urban planning. The strategy also emphasises that 1€ invested into habitat restoration generates 8–38€ profit in Europe.

So, should we develop nature-based solutions or create habitats for species and improve biodiversity? These are the two sides of the same issue. What is good for nature is good for us, humans. For the society and the economy. If we have more NbS, for instance, sustainably managed forests, restored wetlands, wildflower meadows, or green roofs and walls, we provide more habitats for nature. If we protect, sustainably manage, and more importantly, restore natural and modified ecosystems, we not only address societal challenges effectively and adaptively, simultaneously benefiting people and nature (NB. this is the definition of NbS), but we also protect our cities, our economy and our civilisation. Nature provides not only unbelievable benefits for our physical and mental health, but also cheap and aesthetic solutions to develop our cities and reshape our landscapes, to make the long-desired paradigm shift in all areas of economic life. So, what are we waiting for?

A BiodiverCity delegation learns about the dead wood programme in Veszprém
© VKSZ Zrt., Veszprém





Can urban green space be part of the local identity even in an industrial city like Dunaújváros?

© Károly Nagy

“Vitamin N” and our connection to nature

Green space stimulates identity and community spirit efficiently; thus, they are great tools to mobilise citizens. Green spaces can activate pro-environmental behaviour: access to private gardens, for example, can prompt green consumption and changes in shopping habits towards more environmentally-aware purchasing (Barr, 2005). Biodiversity-inclusive green spaces might be advocates of the mindset change required, and besides changing their physical infrastructures and service systems, cities can also promote a more pro-environmental attitude among their residents, along with urban biodiversity management.

This is a key. Bestseller author Richard Louv defined nature-deficit disorder in his book (Vitamin N: The Essential Guide to a Nature, 2016 - where

“N” is for “nature”) and launched an international movement to get humans’ connection back to nature, especially in urban areas where this connection has been dramatically lost over the last centuries, as it was painfully showcased during the COVID-19 pandemic.

In the shadow of inevitable climate change and rapid urbanism, our connection to nature, deeply rooted in cultural values, attitudes and norms, plays a key role when we intend to increase the size and quality of urban green spaces as well as natural habitats and protected areas in and outside of the cities - in line with the EU Biodiversity Strategy for 2030 and the historic Nature Restoration Law.



“Making” diversity, attracting biodiversity, communicating the process properly
© VKSZ Zrt., Veszprém

There is no biodiversity without vital habitats that attract species

Biodiversity is not only about species. It is also about habitats, natural environments where species live and grow. Habitats are characterised by specific physical and biological conditions such as temperature, humidity, soil type, water availability, and the presence of other organisms. Habitats range from aquatic ecosystems like oceans, rivers, and lakes to terrestrial ecosystems like forests, grasslands, and deserts.

Networks of interconnected habitats create ecosystems, each with its own unique set of living and non-living components. These components work together to create a self-sustaining system that provides food, water, and shelter to the living organisms within the ecosystem. If any of these habitats are destroyed or disturbed, it can have a ripple effect on the entire ecosystem.

In urban areas, most habitats are degraded; however, in some cities, even in capitals, as they were often formed on the most biodiverse geographical locations, habitats of community interest can be found. During the process of habitat restoration, ecologists consciously change the characteristics of an area and try to create an ecosystem similar to the native one.

In the simplest case, they simply let the original vegetation recover. For example, many countries have forest reservations, where all direct human activities have been permanently stopped to allow the natural forest processes to operate undisturbed. More often, the original vegetation is still present in the given area but has been significantly reduced. In such cases, efforts are made to reduce the adverse effects. Like during one of the most spectacular forms of habitat restoration, the reconstruction of the original hydrographic conditions in wetlands. It often happens that only traces of the original wildlife can be found in degraded habitats. Habitat rehabilitation can take place in such places, but only if the environmental conditions can be restored. Of course, we can also encounter cases where the original habitat can no longer be restored, but it is possible to create a habitat close to nature.

When talking about (urban) biodiversity, other features of habitat-level diversity might play an important role. Different levels of tree canopy and diversity of the plant forms (e.g. solitary trees, groups of trees, dense forest, solitary shrub, shrub patch) are also very important indi-

cators in assessing urban biodiversity. Species-level diversity can be successfully increased if we increase habitat-level diversity and promote the development of more diverse habitats in urban environments, too, even in completely transformed habitats.

Without habitat-level diversity, which can be enhanced through habitat development, restoration or rehabilitation, species diversity can only be increased to a limited extent and is difficult to sustain. The issue of habitat-level diversity should be an important pillar of urban development and the preparation of investments.

Even its industrial character, Dunaújváros is very rich in urban green spaces
© Károly Nagy





Create diversity of habitats even in the cities! That will attract biodiversity... (Vratsa, city centre)
© Ferenc Albert Szigeti

Why should municipalities deal with biodiversity?

Rockstrom et al. (2009) identified nine so-called planetary boundaries (beyond which anthropogenic change will put the Earth system outside a safe operating space for humanity). Biodiversity loss is the single boundary where current extinction rates put the Earth system furthest outside the safe operating space.

Biodiversity loss is a decrease in biodiversity within a species, an ecosystem, a given geographic area, or Earth as a whole. It is well known that due to many human-driven threads, biodiversity loss is dramatic. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report, up to one million species are threatened with extinction, many within decades.

Decision-makers have finally understood that the different elements of the ecological crisis, as the most pressing issue facing humanity today, have to be tackled together if we are to advance the Sustainable Development Goals and secure a viable future on this planet. The United Nations calls it the triple planetary crisis, having pollution as the third factor besides climate change and biodiversity loss, but actually, degradation of soil is also a major global threat.

It is always better to talk about solutions; however, the concept of nature-based solutions is not new at all. The issue is that, according to the International Union for Conservation of Nature (IUCN), one-third of the climate mitigation needed to meet the goals of the Paris Agreement can be provided by NbS. At the same time, the World Economic Forum states (BiodiverCities by 2030) that NbS are 50% cheaper in urban infrastructure than grey infrastructure, yet they received just 0.3% of overall spending on urban infrastructure in 2021.

So, we need to raise awareness of all actors about the effectiveness of NbS and lead by example. Nature-based solutions are efficient, cheap, aesthetic, and good for nature - so, again, what are we waiting for?

Building on the significant awareness-raising and innovation potential of cities, they also need to nurture citizens and communities to understand, valorise and measure biodiversity and related ecosystem services, enabling them to plan powerful nature-based solutions and foster pro-environmental behaviours. Another factor that makes the role of municipalities essential in the planning and design of nature-base solutions is

the need for cooperation. Implementation of NbS requires strong and efficient communication and cooperation among different engineers, architects, landscape designers, ecologist and urban planners, as well as different authorities since often it is not clear whether NbS need permission for example. Municipalities are the best positioned to orchestrate this process locally.

Within the BiodiverCity network, we often found it more efficient to talk about plants, animals and water than using the lovely, but still too technical term of 'nature-based solutions'.

The ultimate goal is a green transition and nudging residents to be greener. Putting biodiversity into the spotlight, combined with novel nature-based solutions and awareness-raising activities highlighting ecosystem services, can be a more efficient communication strategy than talking only about biodiversity loss, disaster risks and climate crisis.

Although conservation principles are the same in cities as in protected areas, some of them are perhaps more important in the urban context than outside of the cities: awareness-raising, using landscaping projects or nature-based solutions to tackle climate actions such as mitigating the heat-island effect or disaster risks, and the fight against invasive species.

The 10 BiodiverCity partner cities studied and worked on the different aspects of urban biodiversity, and they prepared integrated local action plans to tackle the most pressing local is-

sues. They have jointly learnt that successful management of urban biodiversity must be based on multi-scale, multi-sectoral, and multi-stakeholder involvement. Nature-based solutions provide a realistic vision for cities where the built environment, social structure, and natural capital can co-exist in harmony. In line with the [World Economic Forum's report](#), biodiverse cities can restore balance between cities and nature by:

- 1 Increasing nature in their infrastructure and built environment;
- 2 Improving urban governance models to support nature-based solutions for cities' challenges;
- 3 Nurturing nature-positive values in citizens for health and wellbeing;
- 4 Forging positive links between urban and rural settings and helping to safeguard global biodiversity;
- 5 Prioritising bio-circular economy and bio-inspired innovations for economic competitiveness.

From sustainable urban tree management and wildflower meadows through nature-inclusive buildings and constructed wetlands to bird-friendly policies and community engagement, this guidebook highlights those thematic fields where cities can enhance urban biodiversity, enabling them to put biodiversity as a core organising principle of urban planning.

IMPROVE SOIL LITERACY EVEN IN CITIES!

*WHY DOES SOIL DIVERSITY,
THE ALPHA AND OMEGA OF BIODIVERSITY,
MATTER, EVEN IN URBAN AREAS?*



*Ana Vovk in her permaculture educational
centre with the BiodiverCity partnership
© Ferenc Albert Szigeti*

The dramatic degradation of soil (both quality and quantity) shows that the paradigm shift in agriculture, the No. 1 threat to biodiversity, is inevitable and speeding up the transition is of utmost importance.

“By 1950, half of the world’s land supply had been rendered unfit for cultivation by increasingly intensive agricultural technology” (Poisoned Soil). According to the 6th Assessment Report of the IPCC (Intergovernmental Panel on Climate Change), droughts, heat, and water scarcity will make production impossible on a third of the world’s cropland by the end of the century. Soil moisture in nearly half of Europe’s agricultural areas has declined substantially in recent decades (while agriculture in general consumes 70% of freshwater resources). It is therefore clear from the data that there is also a dramatic erosion and deterioration of soil quality, which

intensive technology users believe can be offset, for a time, by increasing fertilisation. In the meantime, more and more people need to be fed, while more severe droughts cause hundreds of billions of euros of damage in agriculture as well as serious health risks.

By now, we know that with regenerative agriculture methods, it is possible to multiply the amount of soil organic matter in a few years, even on a large-scale farm, while reducing the use of chemicals and machines, but not necessarily reducing yields. Many of us ask the same question: if we are currently in the last moment to save the soil, isn’t it a now and here moment for change, to finally produce healthier food while improving the environment and sequestering a lot of carbon dioxide?

So, it is time to talk about soil biodiversity in our cities, too!

A scene from the movie *Poisoned Soil* showcasing the role of organic matter in soil during drought
© *Poisoned Soil*





A municipality supported deep mulch spot in Veszprém
© Ferenc Albert Szigeti

From urban permaculture to deep-mulch gardens and soil communities - implications for cities

Building on the significant awareness-raising and innovation potential of cities, they also need to nurture citizens and communities to understand the importance of soil diversity. Learn some potential solutions BiodiverCity partners found crucial!



Improve soil literacy by organising deep mulch gardens as community gardens, just like BiodiverCity partner city Veszprém has been doing for 8 years now, as a cooperation between the municipality and a local association. Deep mulch imitates nature, as plants shed their leaves in autumn, and cover the surface, which protects the soil from degradation, compaction, and loss of moisture, and also allows the building of topsoil. In nature, soil is forming, not degrading. It is not only rejuvenating and regenerating, but compared to the previous years, it is also increasing in quantity.

Deep mulch is a 50–60 cm thick cover made of organic waste ready for composting. All kinds of organic waste can be used as mulch locally, with no need to transport the organic waste by using energy and creating emissions, but getting the optimum nitrogen-carbon proportion for com-

posting is important. The soil cover made of organic waste results in the recreation of soil structure and soil biodiversity, while the cover protects the soil from degradation and compaction. Plants' health is strengthened by the rehabilitation of topsoil and its biodiversity, because of the natural nutrition instead of using fertilisers. The deep mulch prevents the soil from freezing, and the mulch is ready for composting in the springtime, which creates heat and warms up the surface a bit earlier. Due to the proper condition of the soil, life is active even in the winter, and the movement in the soil helps us to soften the soil until spring. The deep mulch collects and reserves all the rainwater and gives it to the soil very slowly. Another innovation is the self-regulation, avoiding plant protection by humans at all, even if no biological treatments are needed. *"We believe that there is no organic food without self-protection. If we protect the plant instead of self-protection, the plant will not create high nutritional values. There is a kind of social innovation here, too. Instead of organic waste ending in a waste deposit or a central composting plant, local people can cooperate to provide the appropriate composition of the deep*

mulch by delivering the different types of organic waste locally to each other" says Dr Iván Gyulai, ecologist, university teacher, president of the Ecological Institute for Sustainable Development Foundation, Hungary, who has been demonstrating the efficiency of this technique in his own garden for years.

In Veszprém, the land is given by the municipality free of charge, the NGO coordinates the work, while the community manages the gardens. The garden has a huge potential to showcase how nature works, highlight nature-based solutions, and foster pro-environmental behaviour.

Read our comprehensive [case study](#) on deep mulch gardens in Veszprém!



Create educational permaculture gardens at existing community gardens!

Hundreds of cities operate community gardens, and permaculture-based education centres can stimulate the potential collaboration between humans and nature. *"Permaculture is like a pair of glasses you put on which allow you to see possibilities; that rubble-filled backyard as a food garden, your local community as a sustainable settlement, yourself as part of the hugely complex web of nature and the natural patterns which form the world around you."* (Rob Hopkins). According to the [Permaculture Research Institute](#), *"permaculture is the conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems. It is the harmonious integration of landscape and people – providing their food, energy, shelter, and other material and non-material needs sustainably. Without permanent agriculture, there is no possibility of a stable social order"*. As professor Ana Vovk, founder and owner of the [Dole Self-Reliance Training Ground](#), says: *"Permaculture is not only about sustainable agriculture and producing food. It is about restoring soil diversity,*

fostering biodiversity, using water carefully, building the resilience of local economies, and nurturing people's social existence". Permaculture is a design philosophy and a system for sustainable living that mimics natural ecosystems to create self-sustaining agricultural environments. Permaculture combines elements of organic farming, renewable energy, water retention and community action. According to its three pillars, permaculture highlights the importance of soil diversity, puts humans' well-being in the centre and boosts community action.

Learn about educational permaculture gardens and the importance of soil diversity in the [case study](#) of Dole Self-Reliance Training Ground, close to Poljčane, BiodiverCity partner city in Slovenia.



Organise a permablitz!

Copying from bioblitz (see below), it is an informal gathering of a community to create edible gardens, share skills related to permaculture and sustainable living, build community and have fun (even in a backyard or a small garden). Blitz simply means a focused effort to get something done. These events are always free, led by a qualified expert, with free workshops and shared food, where you get some exercise and have a good time.



Create soil communities by enhancing community composting in the city and

promote composting by providing free-to-use compost boxes. Composting also has huge potential in urban areas, both in private gardens and at community composting spots. Besides the known added value of the "black gold" correctly managed composts can produce (helping plants grow, nourishing the soil, reducing chemical use), it could also significantly reduce the amount of waste we send to landfill sites (not to mention that small hot compost bins and wormeries can even operate on a balcony).

HAVE ECOSYSTEM SERVICES INSTEAD OF PLACEBO TREES

URBAN TREES HAVE A TOUGH JOB



© Municipality of Cieza

It is well known that urban trees provide countless and far the most ecosystem services within the city among the entire greenery to city dwellers, worth millions of euros, and mature trees with their big canopies are our most useful allies in climate adaptation. Let's see a few examples!

 A hectare of mature trees, as a cost-efficient solution, can provide enough oxygen for ca. 30-35 people yearly, while absorbing carbon dioxide.

 Trees play a vital role in reducing the impacts of pollution generated by common human activities. The physical processes of plants that help improve air quality include intercepting particulate matter on leaf surfaces and absorbing pollutants (ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter less than 10 microns). This can be valued at millions of € in a bigger city per year!

 Trees cool the city by up to 3-5 °C by shading our homes and streets, mitigating the urban heat island effect, and releasing water vapour into the air through their leaves. This can translate to reduced energy costs for homeowners. Trees placed strategically around a single-family home can cut summer air conditioning needs by up to 50 per cent. By reducing the energy demand for cooling our houses, we reduce carbon dioxide and other pollution emissions from power plants.

 Urban tree canopies are a nature-based approach to ever-worsening floods. Tree canopies increase the surface area where stormwater falls, decreasing the amount of runoff from reaching the

ground. Root systems serve as water catchment areas that promote infiltration.

Despite all the benefits they provide, we treat our urban trees very badly: they can utilise less precipitation and live in a much drier microclimate than their forest counterparts, and in return, they have to take root in heavily compacted, air-poor soil and cope with a lot of pollution. No wonder our old trees are also being affected by unprecedented heat waves.

That is why a city that cares about itself develops new methods to plant and manage urban trees and works hard to ensure that green infrastructure enjoys equal rights with other infrastructure and, in addition to planting trees, also protects its old trees (creating new green spaces is rather expensive, and with the climate shifting towards extremes in many parts of Europe, it is doubtful that new plantings will survive in the long term).

Cecil Konijnendijk, a well-known expert in urban forestry, created his now world-famous 3+30+300 (fist) rule in 2021, in the midst of the COVID-19 pandemic: there should be at least three large trees in the immediate vicinity of every house, at least 30% canopy cover in every residential area, and a high-quality public park within 300 meters of every home. Due to the increased value of public spaces as a result of the pandemic and the catastrophic effects of global climate change, hundreds of cities are being redesigned in accordance with this simple principle of urban forestry. According to Konijnendijk, in addition to increasing canopy cover, the most important tasks in urban green infrastructure development are the creation of pocket parks in city centres, the establishment of community gardens, and the greening of schoolyards.



Planting carried out by members of
the URBACT-BiodiverCity project on
March 26, 2025

© Ferenc Albert Szigeti

Planting untrained saplings in cities instead of pre-grown nursery trees

BiodiverCity partners first got to know the good practice of Hegyvidék (Budapest, district 12) on planting untrained saplings in cities instead of pre-grown nursery trees. The goal of the program is to grow the trees in their final location from a young age, so that the roots develop while simultaneously adapting to the place, instead of experiencing stress after the "nursery welfare." It is expected that these untrained saplings will adapt better to their planting and habitat conditions than older saplings and, under proper conditions, will quickly catch up in growth with their more trained counterparts. The likelihood of sapling replacement also decreases. Their production does not involve significant horticultural work, and their price and related maintenance are much lower than that of repeatedly trained trees. However, they need special care in the first year.



Untrained saplings better adapt to the underground environment with their root systems. These saplings better adapt to local, rather tough, underground circumstances (pipes, dry soil) with their root system.



Untrained saplings are more climate resilient and healthier in the - often brutal - urban weather conditions. They often face tough underground infrastructure and must grow in much drier air conditions, in compacted soil, coping with serious pollution and potential damage. Through urban heat islands and drought, climate change makes this situation even harder. Nursery trees are usually grown under artificial conditions, and thus, they are not well-prepared for the urban environment.



Through buying untrained saplings (from forestry nurseries), it is possible to plant native species in urban areas, which are often not available in many nurseries, because they grow more slowly and have strong tap roots, which are more difficult to train for proper root-balling. Native species are usually more resilient to climate change.



Untrained saplings are cheaper. It is more expensive to buy, transport, plant and water much higher trees bought from nurseries. The average rate of drying up is higher in the case of nursery trees, thus their replacement is also more often needed. Also, smaller stakes can be used to support the untrained saplings.



Untrained saplings need lower maintenance costs. At the pilot location of Hegyvidék, the only maintenance need was to cut off lower branches. However, in the case of untrained saplings, better communication is need-

ed as well as education of the technical staff (not to cut off the saplings' thin bark with a string trimmer, for instance).



The use of native saplings is a great tool for education and awareness raising linked to biodiversity and climate action.

However, it is important to mention that it is not possible to use untrained saplings everywhere (for example, in newly developed urban downtown areas, where visual and shadowing aspects are important), but their use on side streets can be very effective.



Pilot area in Hegyvidék
© Zsolt Debreczy



Rambla del Realejo Tramo is a great example of how the Municipality of Cieza removes asphalt and plants trees in a sustainable way
© Ferenc Albert Szigeti

Get to know the European Arboricultural Standards!

Second, BiodiverCity partners visited Cieza in Spain, which is a national frontrunner regarding the sustainable management of urban trees. Suffering from more and more serious heatwaves and drought periods, the Municipality of Cieza has understood that urban trees provide inevitable services and cost-efficient solutions for urban dwellers, and it has built up its comprehensive climate action in recent years, entitled Cieza Biofílica, which aims to transform urban green infrastructure into a complex green corridor as the backbone of the city. Over the last few years, Cieza also became a member of Tree Cities of the World, a network initiated by FAO (Food and Agriculture Organisation of the United Nations) and the Arbour Day Foundation, providing further impetus for Cieza. This network works along 5 standards:



Establish Responsibility: The city has a written statement by city leaders delegating responsibility for the care of trees within the municipal boundary to a staff member, a city department, or a group of citizens—called a Tree Board.



Set the Rules: The city has in place a law or an official policy that governs the management of forests and trees. These rules describe how work must be performed, where and when they apply, and penalties for noncompliance.



Know What You Have: The city has an updated inventory or assessment of the local tree resource so that an effective long-term plan for planting, care, and removal of city trees can be established.



Allocate the Resources: The city has a dedicated annual budget for the routine implementation of the tree management plan.



Celebrate Achievements: The city holds an annual celebration of trees to raise awareness among residents and to acknowledge citizens and staff members who carry out the city tree programme.

Besides getting to know Cieza's good practices like the 5-10-20 rule (no more than five per cent of one tree species, no more than ten per cent of one genus, and no more than 20 per cent of any one family should be found in the city or a given area), the BiodiverCity partnership also learnt about the European Arboricultural Standards set by European Arboricultural Council: European Tree Assessment Standard, European Tree Pruning Standard, European Tree Protection Standard, European Tree Planting Standard, European Tree Valuation Standard.

The management of urban trees is a multifaceted responsibility for municipalities, encompassing their planning, protection, assessment, maintenance, and valuation. The published standards emphasise a holistic, sustainable, and data-driven approach to ensure that trees in urban environments continue to provide their essential ecological, social, and economic benefits. According to the standards, the following principles should be followed by every municipality.

Trees planted and managed on a more sustainable way
© Municipality of Cieza





Auróra Climate Garden in Budapest: a green oasis in the dense urban fabric, made on a former parking plot, by using compost and organic waste

© Auróra Klímakert

Strategic Planning and Policy Integration

Municipalities should integrate tree management into their broader urban planning and environmental strategies.

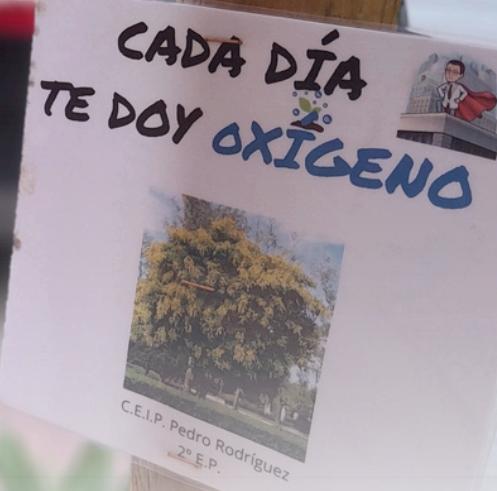
Acknowledge Multipurpose Value: Recognise trees not just as objects but as living entities with inherent rights to space, contributing to biodiversity, climate regulation, and human well-being. The European Green Deal and the EU's Biodiversity Strategy for 2030 emphasise their pivotal role in urban cooling, carbon sequestration, air quality, and creating resilient ecosystems.

Integrate Arboricultural Considerations Early: To proactively minimise negative influences on trees, comprehensive planning strategies must integrate arbo-

ricultural considerations into the early stages of project design and development. This ensures a balance between developmental needs and environmental stewardship.

Promote Green Infrastructure: Actively plan and manage green infrastructure, including urban forests, parks, and street trees, to mitigate the urban heat island effect, enhance air and water quality, and provide recreational spaces.

Target Canopy Coverage: Aim for a minimum tree canopy coverage of 10% in European cities, with further research suggesting a target of 30% in urban neighbourhoods for enhanced microclimate, air quality, and public health.



Communication about the benefits of trees (Cieza)
© Ferenc Albert Szigeti

Comprehensive Tree Assessment (European Tree Assessment Standard)

Municipalities must implement systematic tree assessment to understand the current state, identify risks, and inform management decisions.

Conduct Tree Inventory: Before any detailed assessment, a thorough tree inventory is essential. This includes recording tree identification (positioning, tagging), taxonomic data (species, cultivar), dendrometry (dimensions of stem and crown), geographic coordinates, condition, and it is essential from a communication point of view to include tree value calculations (see below).

Perform Tree Assessment: An initial evaluation of a tree's physiological condition and mechanical integrity to identify its value, potential risks, or issues requiring attention. **Physiological Condition:** Assessed through visual analysis of crown structure, leaf density and quality, and signs of dieback and regeneration. **Mechanical Integrity:** Focuses on the structural condition of roots, trunk, and crown, using systema-

tic observation and simple tools like mallets for sound tests or probes.

Use Advanced Tree Assessment (if needed): For complex cases, or when basic assessment leaves doubts, advanced methods such as aerial inspection, root system assessment, structural calculations/simulations, device-supported diagnostics (e.g., sonic tomography, resistance drilling), phytopathological studies. These require qualified specialists.

Implement Risk/Benefit Analysis: Integrate the tree's benefits and values with the likelihood of decline/collapse and the risk of harm. It's crucial for counteracting a solely "risk-oriented" perspective that might lead to unnecessary tree removals. Non-intervention should always be considered as the first valid management option.

Define Legal Tree Status: Accurately identify and document trees with special

legal protection, such as heritage trees. These are trees with exceptional cultural, historical, or ecological value, recognised for unique features like size,

age, beauty, or historical significance, and often legally protected. Efforts must be made to preserve them for future generations.

More space for trees, more benefits for the city
© Municipality of Cieza





The so-called placebo trees in Cieza that do not really provide ecosystem services

© Ferenc Albert Szigeti

Tree protection during infrastructure works (European Tree Protection Standard)

Municipalities must safeguard trees during all stages of development projects and public events. Provide structured protection along the below systemic approach:



Concept Phase: Recognise trees, establish an initial understanding of potential project impact, and commit to integrating preservation. The output is a Treescape Analysis. This initial survey evaluates the existing tree landscape, focusing on incursion into enhanced heritage and nature protection areas, presence and location of utility protection zones (underground and overhead), overview of green infrastructure and tree population, including water/nutrient resources, wind protection, and biodiversity connections, defining the extent of construction influence on growing conditions.



Pre-Design Surveys: Gather detailed site and tree information, including mapping trees, conducting inventory/assessments, and identifying specific protection requirements. Output: Tree Impact Assessment. It is a specialised

evaluation of potential impacts of construction on trees, analysing factors such as root system disturbance, canopy damage, soil and water changes, chemical exposure, heat sources, light/shade conditions, dust pollution, and ground level changes. It proposes mitigation strategies and recommendations for tree removal/replacement.



Design Phase: Develop a comprehensive plan integrating tree protection, defining detailed measures, and designing layouts that minimise impact. Output: Tree Protection Plan. This strategy safeguards trees during projects using the following tools. Tree Protection Zone: A critical area defined by root system extent (e.g., 8-15 times trunk diameter, or crown projection area + 1-5m radius), where activities are allowed only under specialist supervision. It extends both below and above ground. Fencing: Whenever feasible, the entire Tree Protection Zone should be fenced with a non-moveable, impermeable barrier (minimum 2m height). Temporary or

partial barriers may be used if full fencing is not possible, under arboricultural consultant supervision. Other Protection Measures: Maintain minimum distances from open fires (20m from canopy edge), heat emitters (5m from canopy edge), and chemical/toxic material storage/use (10m from canopy edge); Install sturdy protective structures around trunks (min. 2m height, 10cm from trunk) to prevent mechanical damage. Implement crown protection from equipment or debris; Use load distribution mats or track plates on non-paved surfaces to minimise soil compaction from heavy machinery; Ensure effective watering during dry periods and proper drainage to prevent waterlogging; If ground level changes are unavoidable within the zone, apply permeable fill no closer than 0.5m from the trunk, with strict limits on depth and covered area; Prioritize trenchless technologies (e.g., horizontal directional drilling) for underground utility installation to minimize root disturbance. Use air spades for root ex-

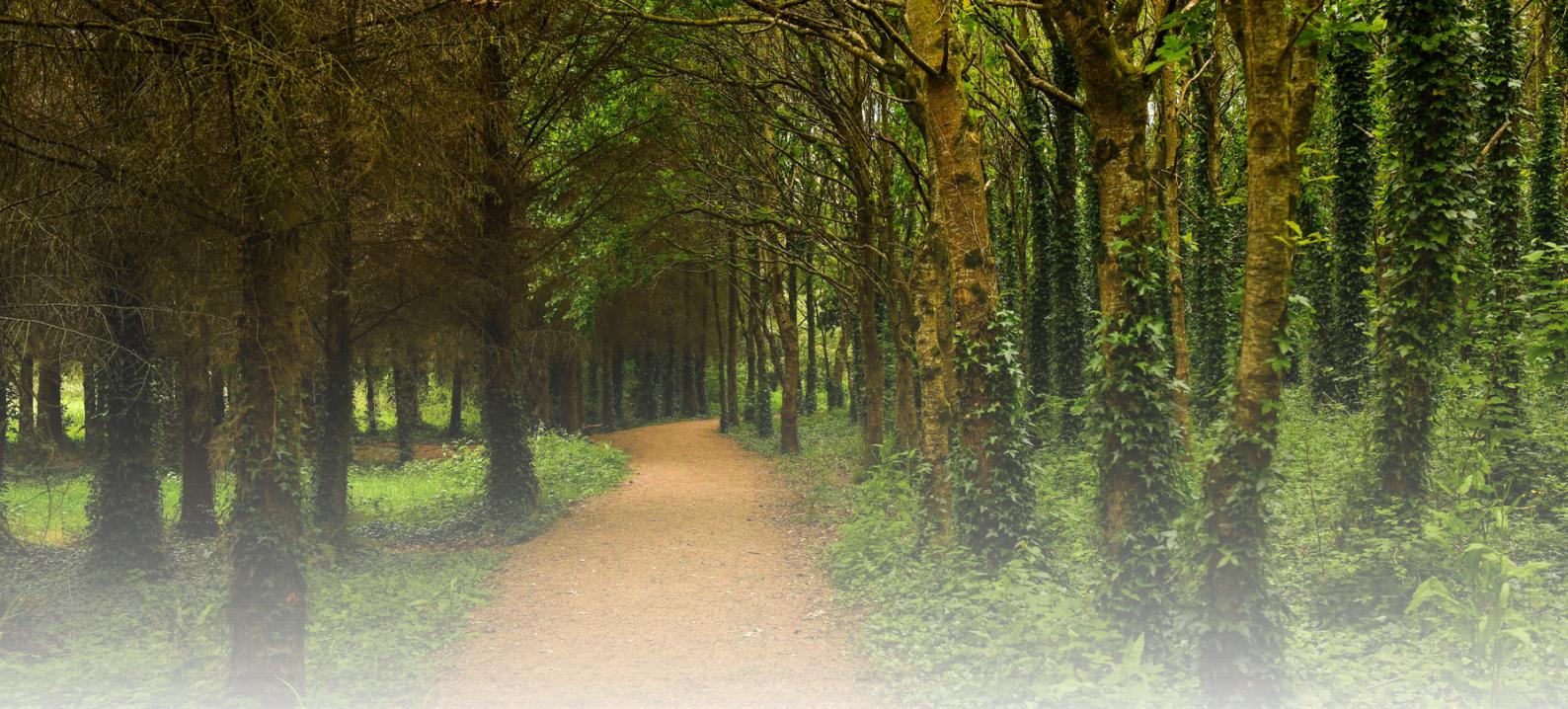
posure before excavation and micro-piles for foundations; Clearly assign roles for tree protection to all stakeholders, including the Head of Construction, Arboricultural consultant, Contractors, Tree Workers, and Construction Workers. Regular communication (formal via construction diary, informal via meetings) is crucial; Diligently remove debris and chemical remains, establish designated storage areas outside TPZs, and ensure responsible disposal to prevent contamination.



Implementation and Monitoring: Execute the project with protective measures, regularly monitor tree health and protection effectiveness, and adjust strategies as needed. Document all activities in a construction diary.



Aftercare: Maintain tree health and safety long-term post-development, addressing any long-term impacts. Include neighbouring trees in the entire process.



Baggot Estate: a woodland “rediscovered” and reassessed during the pandemic
© Limerick City and County Council

Sustainable tree planting (European Tree Planting Standard)

Municipalities should focus on ensuring the successful establishment and long-term development of newly planted trees. Hereby the council's recommendations:

Site Selection and Preparation:

- ✓ **Desktop Research & Field Survey:** Conduct initial desktop research on future urban development plans, utility networks, and legislative restrictions (e.g., heritage, nature protection). Follow with a field survey to assess growing conditions, including above-ground space, soil properties, compaction levels, and water infiltration.
- ✓ **Underground Space (Rootable Volume):** Ensure sufficient underground growing space for roots to develop sustainably, with at least 0.5m and usually no more than 1.5m usable depth. Avoid conflicts with infrastructure by respecting minimum obstacle-free distances (0.5m to 3m).
- ✓ **Soil Conditions:** Understand soil types and their properties (drainage, aeration, water retention). For degraded soils, im-

plement soil improvement (decompaction, mixing layers, amendments, or replacement) across the full rootable volume, not just the planting pit.

- ✓ **Hard Surfaces:** When planting in hard surfaces, utilise auxiliary technical solutions like structural soils, soil cells, or tree bunkers to provide rootable volume and ensure gas exchange.

Tree Species Selection:

- ✓ **Site Suitability:** Select species based on site conditions (altitude, solar/wind exposure, soil, landscape topography). Consider resistance to frost/drought/heat.
- ✓ **Biodiversity:** Prefer local/regional sources of planting material to maintain natural genetic variability. Improve species diversity on the site to enhance resistance to pests and diseases.
- ✓ **Specific Requirements:** Account for special requirements from the planting site and desired tree functions (e.g., clearance, maximum height, salt tolerance for roadside plantings).

- ✓ Avoid Invasive Species: Restrict the use of invasive alien species.

Tree Stock Quality:

- ✓ Prefer Smaller Stock: Generally, recommend planting smaller trees (preferably 12-16 cm stem circumference) as they suffer less from planting shock, adapt better, and require less intensive aftercare. Larger stock may be used for immediate visual impact or vandalism risk reduction, but requires longer establishment periods.
- ✓ Quality Checks: Ensure trees are free of diseases, pests, and invasive plants. Check for solid stems with normal taper, no bruising or open wounds, and healthy, well-branched root systems without circling or girdling roots. Root balls must be compact and cohesive, and for container-grown trees, the tree should have grown in the container for at least one full growing season.

Standard Planting Procedure:

- ✓ Timing: Plant bare-rooted/root-ball trees during the dormant period. Container-grown trees offer more flexibility, but avoid frost or high temperatures.
- ✓ Transport & Storage: Protect trees from sun, wind, frost, and mechanical damage during transport and temporary storage. Water sufficiently and store bare-rooted trees within 24 hours, and root-ball/container trees within 48 hours.

- ✓ Root Management: Remove damaged or circling/strangling roots. For container-grown trees, cut small curving roots or shave the outer 2cm of the soil mass.

- ✓ Planting Pit: The pit should be at least 1.5 times wider than the root system/ball. Loosen the bottom and walls. In compacted soils, angular or radial pits are better. Use layers for backfilling, compacting gently, and ensuring the root collar is slightly above the surrounding terrain after settling.

- ✓ Anchorage Systems: Stabilise trees over 1.5m height. Use 1-3 stakes or underground anchors, allowing some trunk movement. Install stakes in the open pit to avoid root damage. Maintain anchorage for 2-3 growing seasons.

- ✓ Stem & Crown Protection: Install protection against sun scorch, gnawing/browsing, and mower damage. Ensure protection systems allow for trunk growth.

- ✓ Mulching: Apply a 5cm layer of organic mulch (max 10cm in dry climates) around newly planted trees, keeping it away from the root collar.

- ✓ Water Supply Systems: Create irrigation walls or use slow-release irrigation sacks. For specific needs, in-situ irrigation pipes can be used.

- ✓ Pruning at Planting: Generally, quality nursery stock should not require pruning at planting. Only rectify minor transport damage or specific structural needs.



Juan 23 Avenida in Cieza (2015): full of “placebo” trees before the change of the local pruning policy
© Municipality of Cieza

Effective tree pruning (European Tree Pruning Standard)

Municipalities should manage pruning with clear objectives, prioritising tree health and safety while considering biodiversity.

- ✓ **Define Clear Objectives:** Pruning should be carried out for specific objectives, such as safety (people, traffic), clearance (buildings, infrastructure), managing trees for optimal benefits, or pest/disease prevention. Avoid pruning for trivial perceived problems like shading of solar panels or leaf fall, as interventions can harm ecosystem services.
- ✓ **Minimise Wounds:** Pruning wounds must be minimised. Prefer multiple small cuts further from the trunk over large cuts directly on the stem, except for formative pruning in young trees. Wound sizes should not exceed 5 cm (weak compartmentalisation) or 10 cm (good compartmentalisation).
- ✓ **Optimal Pruning Season:** Pruning during the growing season is generally preferred to support wound reactions. Avoid pruning during post-dormancy

(spring), pre-dormancy (autumn), or long periods of drought. Species with intensive sap flow should not be pruned during dormant periods. A special attention to be given to animal (bird) species when planning the pruning season.

- ✓ **Regular, Timely Interventions:** Start pruning early in a tree's life for predictable issues and repeat regularly. Young trees benefit from regular, small interventions (every 2-3 years), while mature trees should only be pruned when necessary.
- ✓ **Deadwood Management:** Dead branches are a natural part of a tree and are important for biodiversity. They should generally be retained unless they pose an unacceptable risk of falling (e.g., over 5cm in diameter and 1m in length in permanent crowns). For veteran trees, deadwood should be preserved as much as possible to protect habitat and decay processes, while keeping risk acceptable.

Specific Pruning Operations:

- Structural Pruning: Shapes the crown of young and semi-mature trees to ensure a dominant stem and stable structure, providing sufficient clearance.
- Lateral Crown Reduction: Reduces the side or lower parts of the crown to eliminate conflicts with structures or improve stability, without altering tree height.
- Upper Crown Reduction: Reduces the apical part of the crown, primarily for biomechanical stabilisation of the whole tree. This is an exceptional intervention for mature trees and should only be done if justified by instability and after considering alternatives like cabling/bracing.
- Crown Shaping: Irreversibly alters a tree's natural architecture (e.g., pollarding, trimming) and must be started when the tree is young and sustained throughout its life with regular pruning.

lar, short-interval pruning. Do not start shaping on mature trees.

Restorative Pruning: Carried out on mismanaged, neglected, or mutilated trees to re-establish a semi-natural or artificial shape. Objectives and techniques depend on the tree's status and development stage.

Veteran Tree Management: Interventions in veteran trees must be carefully considered and planned as specialist work by certified professionals. The focus is on weight reduction for biomechanical reasons and managing epicormic shoots, preserving internal crown structures and habitat features. Avoid crown lifting or removal of epicormic growth in the lower parts.

Biosecurity: Implement strict biosecurity measures, including cleaning and disinfecting tools between trees, especially when pruning trees with contagious pests or diseases. Report quarantine diseases or pests to national plant health authorities.

*Juan 23 Avenida in Cieza (2025): after the change of the local pruning policy
© Municipality of Cieza*





Using Stockholm Tree Pits is a part of the water retention measures in Ecocity Augustenborg (Malmö)

© Ferenc Albert Szigeti

Tree Valuation and Compensation (European Tree Valuation Standard)

Municipalities should accurately define and calculate tree values to support informed decision-making, felling permits, and compensation for tree loss.

Holistic Valuation Approach: Tree valuation should encompass ecological, social, and aesthetic contributions beyond mere financial metrics. It is recommended to apply a variety of approaches, fostering interdisciplinary collaboration for sustainable urban development.

Recognise Diverse Tree Values: Property Value: The enhancement in the monetary worth of land/property due to tree presence; Repair Cost: Total expense for addressing permanent, repairable damage; Replacement Cost: Total expense for replacing a lost tree with a comparable one, including removal, site prep, purchase, planting, and initial care. This is suitable for trees primarily serving as botanical specimens or smaller/shaped trees. For irreparable damage, replacement costs are crucial.

Ecosystem Services Value: Quantify benefits like temperature regulation, carbon storage/sequestration, air quality improvement, noise mitigation, and water regulation. Older and larger trees typically provide greater services. **Biodiversity (Wildlife) Value:** Focus on habitat biodiversity, recognising trees as vital contributors to diverse habitats. Older, larger, native, and connected trees (ecological corridors) have higher biodiversity value. **Disservices:** Recognise and incorporate negative impacts such as maintenance costs, infrastructure damage, allergens, or water consumption into the valuation for a balanced assessment.

Felling Licenses and Compensation: Felling licenses are formal authorisations for tree removal, ensuring conscientious removal and often stipulating compensatory actions (replanting or financial payments) to counterbalance environmental loss. The valuation report for damage should not be more than 6 months old for official recognition.

- Approach to Groups of Trees: When assessing tree groups, focus on the impact on canopy coverage rather than just the number of trees removed, as similar trees within a group share and distribute ecological and aesthetic contributions. However, removing a single tree can still adversely affect the entire group.
- Data-Driven and Adaptive Management: Leverage technology (GIS, remote sensing, big data) for gathering and analysing

information. Recognise that tree value is not static and evolves, requiring adaptive management principles and continuous monitoring. Engage communities as essential stakeholders in the valuation process.

By implementing these comprehensive practical steps, municipalities can effectively manage their urban tree populations, maximising their benefits for both the environment and their communities, while adhering to European arboricultural standards.

Cieza has completely changed the model of how urban trees were managed before, and it is well described in a new management plan
© Ferenc Albert Szigeti



WILDFLOWER MEADOWS IN THE CITY

*CLIMATE-ADAPTIVE GRASSLAND
MANAGEMENT IN URBAN ENVIRONMENTS*



Margins mean: "this is not neglected,
but biodiverse" (Veszprém)
© VKSZ Zrt., Veszprémi

Besides trees, the rich biological and ecological diversity of grassland areas, even if substantially different from that present in natural environments, is also a key asset in the city. Gardens, parks, promenades, urban waterfronts, roadsides, and ditches are all valuable grassland habitats that, in addition to their recreational role, have also become essential for nature conservation and climate adaptation.

Created and maintained by man, urban lawn and grassland areas are versatile green spaces. They are places for picnics, dog walking and outdoor sports. Homogeneous lawns consisting purely of grass species, however, are sensitive areas that require a lot of care. Intensely used lawn consisting of a mixture of a few monocots can only survive with regular mowing, irrigation, nutrient replenishment, plant protection and soil care. As a habitat, the lawn is not particularly diverse. It is susceptible to diseases, and it requires considerable resources to keep it in good condition and to care for it regularly. Constant care and intensive maintenance processes lend an artificial, urban character to urban lawns.

A semi-natural urban grassland is more resilient to external disturbances and provides habitat and food for a greater number of animals, simply because of the combination of several plant and animal species. It can be an excellent bee pasture or even a source of hay. Urban wildflower meadows have a natural character, bringing nature close to the people in the city. They require much less maintenance than a lawn but demand a different kind of expertise. As the stubble is taller, the usability of the urban meadow is limited. Tall grass can be suitable for traffic islands, edges, steep slopes, or underutilised green spaces. Because of its natural appearance, it often looks untidy and unmanaged to the untrained eye.

All kinds of grassland can be appropriate in urban green spaces. Choosing the type of grassland to be created will depend on the site

conditions and the function of the green space. Even within a single garden or park, several zones may be established with various characters and management practices.

Since the tree canopy reduces the radiation from the ground surface at night as well, the temperatures of the surface and the air above the surface are more evenly balanced. The grass surface heats up easier during the day. Since nothing impedes surface radiation at night, the grass cools down faster; therefore, dew and ice formation are more frequent. Uncovered, grassy areas contribute to cooling the air to a greater extent compared to wooded areas because, although they heat up more during the day, they cool down faster at night, producing cold air in the city. Urban gardens and parks tend to have higher temperatures in the winter and lower temperatures in the summer compared to the surrounding streets and squares without any trees. This small temperature difference is sufficient to create local air currents that contribute to the air exchange in and regeneration of built-up areas.

Explore the story of Veszprém (HU), whose flagship project, the climate-adaptive grassland management in urban environments, has been awarded as a [URBACT Good Practice](#). Today, the municipality of Veszprém cultivates ca. 5000 nm² across the city in this sustainable way, paying special attention to prefabricated housing estates. The new management method consists of other biodiversity-driven maintenance techniques, like leaving leaves in dedicated spots to provide a wintering area for hedgehogs and insects.

Read the comprehensive [case study](#), co-created by the Veszprémi Közüzemi Szolgáltató cPlc. (the public utility company) and the Hungarian University of Agriculture and Life Sciences, Faculty of Landscape Architecture and Urban Planning, to understand how this systematic framework works in Veszprém so successfully and learn about how this policy supports urban biodiversity and climate change adaptation.

NATURE-INCLUSIVE BUILDINGS

*WHEN THE DENSE URBAN FABRIC YET HAS
LOTS OF FREE SPACE FOR GREENING*





On the rooftop of the communal utility company in Malmö, a huge green rooftop operates as an experimental place of different techniques ([Botanical Roof Garden](#))

© Ferenc Albert Szigeti

Green roofs

Vegetated building roofing dates back to at least the Neolithic Era (8000–4000 BC), as it protected buildings in harsh and climatically extreme environments. The Swiss-French architect, Le Corbusier, was already talking about green roofs in 1927 and listed them among his 'Five Points of Modern Architecture' (pillars, roof garden, open floor plan, long windows and open facades).

Green roofs are divided into extensive green roofs, which require little maintenance and management and have a light construction, such as moss-sedum-herb roofs; and intensive green roofs, which are heavier and have irrigation systems and can also provide substantial water storage. Extensive green roofs can be applied later to existing buildings due to their lighter weight. Intensive green roofs range from watered grass-herb roofs to walkable city parks on buildings.

Green roofs have many advantages over conventional roofs: they can add attractive usable space to highly densified urban areas, they have a more attractive appearance, they improve local biodiversity and might retain 70–90% of the rainwater. But above all, they are also efficient in the insulation of buildings (and thus

provide longer life for the roof structure). According to a [report](#) made in Hungary, while the annual temperature fluctuation on a roof covered with river gravel reached 100 degrees Celsius, this decreased to 34–36 degrees Celsius on a 10 cm thick extensive green roof.

By varying the type of plants, the planting density and the water storage on the roof, the temperature above the roof structure can be influenced and thus the heat flow through the roof. Studies with a similar climatic situation as in the Netherlands show that a green roof can reduce the average daily heat flow in summer (inwards) by 70 to 90% and in winter (outwards) by 10 to 30%. Naturally, the percentage depends on the insulation value (year of construction) of the roof in question. The effect is smaller on well-insulated roofs.

Green roofs offer a solution for the new regulations that more and more municipalities across Europe are coming up with regarding local water storage in new developments and redevelopments. The requirements of 50 to 200 mm rainwater storage on private lands in the urbanised area can often only be achieved with substantial water storage on the roofs. In the

context of nature-inclusive construction, greening large parts of the plot surface is a requirement, and the roof offers a solution for this as well.

Last, but not least, green roofs might attract a significant number of species. In Budapest, for example, on the top of a shopping mall, in the second year after installation, 160 plant species

were counted on the non-irrigated roof, and in addition, the surface always shows a different face due to the changing weather conditions each year, in which new and even protected species have appeared in the meantime. In leading cities, thousands of square meters of "wildflower meadows" are now being planted, often on the roofs of public institutions, thereby setting an example for the population.

*Many cities in Europe are experimenting with artificial structures
to help climbing plants grow on the facades
© Ferenc Albert Szigeti*





Climbing plants: the easiest way, often blocked by culturally driven aversion (Copenhagen)

© Ferenc Albert Szigeti

Green walls

Vertical vegetation is currently of interest to many municipalities, and some of them also intend to encourage residents to use climbing plants. For centuries, certain climbing plants have been used to adorn building facades. Recently, in the larger cities, this vegetation is used for many more purposes, such as capturing fine particulate matter and contributing to the cooling of a city. The advantage is that it takes up little space in an already intensively used urban area, while providing many vertical metres of green and cools down the city directly at the street level.

Vienna's world-famous green façade covering the headquarters of the Municipal Department for Waste Management consists of approximately 17,000 herbaceous plants over an area of 850 square meters, and its cooling effect in summer is equivalent to the 8-hour operation of 80 air conditioning units, while in winter it reduces heat loss by about 50%. Green walls can also absorb rainwater, but not as much as green roofs.

There is a lot of discussion surrounding the pros and cons of green facades. Now that their positive effects have become clear regarding their role in capturing fine particulate matter (although this is very relative and site specific) and lowering urban temperatures, the objections to green facades regarding moisture, damage to buildings and nuisance from pests are diminishing. Evergreen plants can actually protect a building against heavy rain showers and keep the building walls dry. However, buildings which are already affected by rising humidity due to existing construction faults or damage can actually be further damaged by vegetation, as it inhibits the evaporation of moisture. Because many disbeliefs still exist, frontrunner cities like Vienna not only financially support residents to use climbing plants but also offer expertise. Planners should not forget that a climbing plant which can cover a five-story building in the span of a few years requires sufficient space for its roots to remain healthy.



*A modern, award-winning hanging garden in Budapest
© Ferenc Albert Szigeti*

Shadowing with green

One of the most effective ways to keep people cool in urban spaces is often neglected in urban planning: simply providing shade. Famous examples of providing shade by using vegetation can be found around the globe. Four different categories of street shadowing with green can be defined: 1. Climbing plant structures, green pergolas; 2. Climbing plants covering a street; 3. Green planters and 4. Hanging structures.

Green rooftops and walls have become an integral part of urban areas across Europe. The green and increasingly multifunctional rooftops and walls help us achieve the objectives of sustainability, health and a safe urban living environment. Discover the world of green rooftops, walls and green street shadowing in the [study](#) written by Marieke Mulwijk, ad-hoc expert of the BiodiverCity network.

FROM CONSTRUCTED WETLANDS TO SUSTAINABLE URBAN DRAINAGE SYSTEMS

THE BLUE IS THE NEW GREEN



Water retention basin in Malmö
© Ferenc Albert Szigeti

While climate change is changing precipitation patterns across Europe and “never seen” droughts hit the continent, due to urbanisation (only 5% of the rainwater can be infiltrated in a dense city) and lack of capacity of the traditional sewage systems, rainwater retention and the sponge city concept originally born in China have been an important urban planning question in most of the old continent. Not only does increasing urban runoff play a role here as a natural disaster in cities, but extreme heatwaves also have serious health-related implications. Due to the dense urban fabric, the air tempera-

ture in the centres of large cities is generally 3-5 °C higher compared to the values measured in the surrounding natural environments. In certain cases, for example, in the downtown area of Budapest, which is very poor in green spaces even by international comparison, the difference can be as much as 8-12 °C! Cooling the air through evaporation (by vegetation or water bodies) is an important urban goal within climate adaptation. Learn about the most important implications BiodiverCity partners have found important during their learning journey.

The power of wetlands or be ready to give some space back to nature for effective climate action!

Most parts of Europe are facing increased frequency of meteorological drought, heavy winter (and partly summer) precipitation, as well as heat waves. In line with the EU Biodiversity Strategy for 2030 and the historic Nature Restoration Law, we need to install water retention measures at all territorial levels, we need to improve the quality (and quantity) of our urban green infrastructure, and we need to halt biodiversity loss. The Biodiversity Strategy encourages member states to increase their protected areas by restoring natural habitats. Thus, free-flowing rivers have been a crucial theme since wetlands can effectively feed groundwater into drying-out landscapes. Landscape-level water retention also highlights very well how nature-based solutions work and

why nature is our best ally to combat climate change. “Wetlands are the world’s most effective carbon sink, storing twice as much carbon as the world’s forests”, says the Interreg Europe Policy Brief. Their protection and restoration are thus not only “good” for biodiversity, but critical in climate change mitigation and adaptation too. Landscape-scale restoration of wetlands will result in the creation of healthy ecosystems, better soil health, improved water cycles, enhanced biodiversity and protection against natural disasters. However, while nature-based solutions are considered the preferred solution on global and EU levels, they are important in cities too as excellent risk mitigation tools. So, the question is also valid in the urban context: are you ready to give some space back to nature?

Green is an inevitable part of the sponge city concept, but not always enough...

Nature-based solutions are effective tools to absorb runoff water. Trees are important players in the sponge city story as their canopy can absorb lots of rainwater, not to mention the retention capacity of the healthy soil. Frontrunner cities, like BiodiverCity partner city, Cieza, use Sustainable Urban Drainage Systems (SUDS) everywhere where it is possible. SUDs mimic natural drainage processes to manage urban stormwater, focusing on infiltration, storage, and treatment of rainwater close to its source. Unlike traditional piped systems, SUDS

utilise elements like rain gardens, permeable pavements and different drainage ditches to reduce flood risk, improve water quality, and enhance biodiversity in urban environments. Other cities “restore” urban trees with, for instance, the Stockholm Tree Pits method, providing more space and air for the roots. These methods are also important for the trees themselves since heatwaves challenge urban trees very much as they must grow in much drier air conditions, in compacted soil, coping with



Water retention basin in Guimarães

© Ferenc Albert Szigeti

serious pollution and potential damage. However, every location is different, and we face more severe storms; thus, it is important to mention that nature-based and other water retention

solutions (e.g. using barrels by residents) usually cannot absorb all rainwater during heavy rainfalls, traditional, grey solutions, smart technologies and residential programs are also needed.

Public green spaces as water retention basins

It is perhaps also time to rethink the role of urban parks that usually open windows for nature for thousands of urban dwellers. Are you ready to combine their recreational function with water retention and biodiversity? For example, Sankt Kjelds Plads in Copenhagen, a green area opened in 2019, can handle large volumes of rainwater by a network of raingardens and SUDs, while 9000 m² of asphalt has been replaced with 586 trees, perennials and grassland. This project was the first among the approximately 300 projects to protect the city against flash floods in the future. Enghaveparken, built in 1928, was redesigned in 2014, and the public park can now retain 22.600 cubic metres of rainwater. In Malmö, a communal park becomes a water irri-

gation basin in times of heavy rainfalls, as part of the award-winning [Ecocity Augustenborg](#) project. This neighbourhood became a testbed of Malmö city in 2001 because heavy rainfalls caused serious damage in those years, and this area, with its ca. 1800 apartments, is 97% owned by the municipality. This important factor enabled the municipality to prepare the district's unique stormwater management and green infrastructure system, strongly based on community engagement. Now 6 km of local canals, green rooftops, raingardens and 11 ponds collect, delay or store rainwater, and even the greywater of washing machines is purified in natural ponds too.

Have an integrated strategy to tackle and model rainwater runoff, and find the owner of the theme!

In the last two decades, Copenhagen has also experienced major rainfall events. The [Cloudburst Management Plan](#) (2012) is one of

the greatest European examples of managing heavy rainfalls in the city. As a part of it, Copenhagen has been working on transforming



A small rain garden in a neighbourhood (Berlin)
© LIFE in Runoff partnership

its green areas into climate-proof green spaces, highlighted as one of the key directions of future architecture by the [Copenhagen in Common](#) exhibition (2023) at the Danish Architecture Centre. One of the key lessons from frontrunner cities is that through initiating a professional dialogue between landscape architects, urban planners and various engineers (water, utility, and transportation), urban rainwater harvesting

has been an integrated part of urban development because capturing and utilising extreme amounts of rainfall requires the collaborative thinking of these professionals. Efficient and integrated interventions also need a scientific analysis of urban runoff, consisting of both surface and sewage runoff and infiltration capacities. This is rather complicated since every curb might matter.

The secret of completely blue neighbourhoods

In Berlin, for example, where a [Rainwater Agency](#) coordinates blue aspects of urban development, complete residential areas (e.g. Rummelsburger Bucht) were born in recent years without having grey infrastructure (channelisation) for rainwater. How is it possible? In Germany, there is a separate taxing system for the collection of rainwater and sewage water. In Berlin, the volume of a local tax and the tax relief system related to rainwater collection is a key driver of building green rooftops, green walls, rain gardens, and other types of sustainable ur-

ban drainage systems, and using permeable surfaces instead of building grey infrastructure to channelise rainwater. These incentives play a crucial role in activating companies and private owners. For instance, Basel started to financially support residents back in the 90ies to build green rooftops, and the initiative was so successful that the city became a world record holder for the use of green rooftops per capita (5,71 m² in 2019) and the municipality finally deleted the support scheme.

One curb might matter...

Are you ready to rethink your values, customs and legislation? Big changes often require small steps. Paying attention to climate adaptation in due time led frontrunner municipalities to rethink values and customs. This resulted, for example,

in the fact that it is now possible in Berlin to lead rainwater away from roads up to 10.000 cars per day to neighbouring raingardens located next to the roads. Is it legally possible in your city?



Reconstructed wetland just outside of the ancient city walls (Den Bosch)

© Ferenc Albert Szigeti

The big question of urban water retention

However, a core question remains open even in frontrunner cities like Berlin: how to establish urban water retention measures in the existing, especially historic urban fabric, where there is simply no space under the ground (and money) to increase the capacity of the sewage system, where sometimes the plantation of a single tree is challenging. The basic issue is that old pipelines (in bigger European cities, at least in their centres, there are typically mixed sewage systems, meaning that the same pipeline absorbs rainwater and sewage water) simply cannot absorb the large volume of rainwater of a

big thunderstorm. It is also true that these mixed pipelines need rainwater from time to time to flush the system. Regarding the dense urban fabric, a well-known example is [Tåsing Square](#) in Copenhagen, which was transformed from a plain grass area and parking spaces to a green oasis. Excellent example of the integrative aspect of green infrastructure planning, but it is important to mention that while green areas have increased across all of Denmark in the last decade, they have only declined in Copenhagen, despite the above successful projects.

Activate residents!

Very often, the most urban green area is owned privately. In the shadow of the ecological crisis, it is thus crucial to engage residents and local companies, nurturing them to more pro-environmental behaviours and using more biodiversity-driven approaches in their gardens, making them more resilient to the negative impacts of climate change too. This might include not only the distribution of barrels but the build-

ing of rain gardens, green roofs and walls too. According to the [Fifth Assessment Report of the Intergovernmental Panel on Climate Change \(2022\) - Impacts, Adaptation, and Vulnerability](#), pioneer city interventions (e.g. Philadelphia) suggest supporting private stormwater infrastructure tools to reduce stormwater at a much lower cost than increasing stormwater storage capacity interventions.



A few years ago it was even not clear who can plan a rain garden (Budapest's first rain garden)

© Ferenc Albert Szigeti

Use Natural Water Retention Measures and create a Watershed Coordination Forum!

A city, especially a smaller one, is never independent from its geographical context. Hundreds of smaller settlements are working on water retention measures to mitigate the effects of flash floods. Natural Water Retention Measures (NWRMs) are multi-functional small-scale measures that aim to protect and manage water resources and address water-related challenges by restoring or maintaining ecosystems as well as natural features and characteristics of water bodies using natural means (e.g. log-dams, swales, hedgerows, buffer strips, ground dams, infiltration ponds) and processes, so that water can better infiltrate and be stored. A decentralised network of NWRMs can represent cost-effective options to protect urban areas from flash floods and increase the resilience of

the landscape to droughts. They can be part of sustainable urban development plans to reduce investments in expensive water infrastructure. The case of Püspökszilág, a model settlement of NWRMs implemented in hilly areas and an URBACT good practice city, for instance, demonstrates how upland municipalities can effectively respond to climate change vulnerability through integrated, basin-scale, cheap NWRM implementation. In addition to this, the establishment of the so-called Watershed Coordination Forums is also essential since flash floods cause challenges in the entire territory of the watershed, and such a platform creates an opportunity to align the numerous professional, legal, technical, and environmental aspects.

BIODIVERSITY- INCLUSIVE URBAN PARKS

*RURAL LANDSCAPE ELEMENTS
IN THE CITY*



*The award-winning Pünkösdfürdő Park in Budapest
© Ferenc Albert Szigeti*

It is perhaps also time to rethink the role of urban parks that usually open windows for nature for thousands of urban dwellers. Are you ready to combine their recreational function with biodiversity and water retention?

Increasing the size and improving the quality of urban green spaces is an utmost priority of all European cities in the shadow of the ecological crisis. This is also required by the EU Biodiversity Strategy for 2030 and the related Nature Restoration Law. Using innovative tools and methods within the maintenance of public green areas makes green infrastructure more biodiverse and resilient to climate change, but these old-new methods also have great awareness-raising potential. In many public parks, social, recreational and aesthetic functions have priorities, but even those popular green areas - not to mention the lots of other, less used green areas - can be managed according to a differentiated and environmentally friendly approach so that they can be used simultaneously for social, recreational, educational, aesthetic and environmental purposes. Hereby is the list of the most important possibilities for fostering sustainable and biodiverse maintenance of public green areas, prepared based on a [BiodiverCity case study](#).



Let's get orchards back in city parks!

Having fruit trees on the streets is often a sensitive question: people tend to complain about falling fruit, the related smell and insects attracted by them. Having them in public green spaces is another story since they can significantly increase the biodiversity of a given location, and the fruits do not make so much "trouble". For example, Budapest created its first experimental orchard in the award-winning Pünkösdfürdő Park, planting a total of 75 trees from 24 different species. Edible forests have a long literature, and community harvesting in a park is great fun!



Let's get shrubs back in city parks!

The same applies to shrubs. We removed them from parks some decades ago in many parts of Europe due to various reasons (safety, mainte-

nance). Nowadays they are appearing again in less frequented parts of public parks since their existence is essential for biodiversity (providing food and hiding places for insects and birds).



Support pollinators!

Urban areas, sadly, have become key in halting the decrease in the number of pollinators caused mainly by intensive agriculture. Public parks that have lots of unused areas are ideal places to support pollinators by using seeds of native species to enrich urban wildflower meadows or by creating bee pastures, artificially flowered areas. This practice offers valuable educational opportunities for residents to learn about the essential role of pollinators in ecosystems.



Let trees grow faster!

As more and more cities experiment with the Miyawaki Method (named after Akira Miyawaki, a Japanese botanist), more and more facts prove its success: it helps trees grow faster and increase biodiversity. The method takes its inspiration directly from processes and diversity in nature: different species of trees and shrubs are planted close to each other, and this plant community works very well together; they strongly compete for the sunlight, and perfectly adapt to local weather conditions. Vegetation becomes much denser than conventional plantations, and it has the structure of a mature natural forest.



Use landscape mosaic in public green areas!

Recreation often has priority in most parts of a public park, but not everywhere. Why not make the park landscape closer to the rural landscape, which originally had a mosaic structure? Make your public park more attractive and biodiverse by featuring a diverse array of habitats, including open grassy areas dedicated to recreation, wilder wooded sections with native trees and shrubs, flower beds, raingardens and ponds, wildflower meadows, etc. This variety supports a rich biodiversity of plant and animal species, providing recreational spaces for visitors while enhancing the ecological health of the urban environment.



Consciously planned landscape mosaic (perennials, wildflower bed and mown) at Pünkösdfürdő Park (Budapest)

© Ferenc Albert Szigeti



Plan the length and variety of the margins properly!

Margins are also important in preserving biodiversity. It is very important to plan border strips between different habitat patches of different character (e.g. patches of shrubs between a wooded park area and the open meadow, or a strip reminiscent of a swamp between the meadow and a pond). These edges have a special role in biodiversity; they are important hiding and feeding places.



Planting perennials instead of annual flower plants!

Perennial beds embody resilience and cost-effectiveness, requiring only a one-time planting. Their remarkable ability to absorb and retain rainwater, releasing it during dry periods, significantly benefits urban climates.



Managing organic waste locally!

There is no bigger waste in a green area than collecting fallen leaves (by using manpower or gasoline) into plastic bags and transporting the organic material needed for plants to another place. Of course, recreational areas have other priorities, but a public park has lots of parts where leaf litter can work as a natural mulch, preserving soil moisture and maintaining soil tem-

perature to support plant growth. It also offers a hotel for hedgehogs, providing a safe environment for hibernation and raising their young while attracting insects and other small creatures.



Create a hedge made of fallen branches and leave dead wood on the site!

You can build a hedge with cut-off or fallen branches piled together in a line or structure, providing a cosy home for wildlife. These hedges, besides providing habitat for wildlife, might help with soil erosion control in gardens and natural areas. They are an eco-friendly way to recycle garden waste and promote biodiversity.



Support birds and bats!

Birds are especially important, not only for the ecosystem but for humans enjoying the green area too. We can help them (as well as bats and often small mammals) with nesting boxes specialised for different species. We can help nesting birds if there is no reconstruction during the nesting period. You can enhance tree health assessments with ecological surveys and schedule non-urgent tree maintenance outside the nesting season. Exceptions are made for hazardous trees requiring immediate attention, and in those cases, relocating bird nests is possible.



Biodiversity makes recreational green areas more beautiful (Pünkösfürdő, Budapest)

© Ferenc Albert Szigeti



Become pesticide-free!

In 2009, the European Union Member States approved Directive 2009/128/EC of 21 October 2009 on Sustainable Use of Pesticides (SUDP), and the movement of towns going pesticide-free is growing. However, many towns, regions and countries had already decided a long time ago to become pesticide-free. Learn from the pioneer [Pesticide Free Towns!](#)



Sheep grazing in urban areas?

It is a more advanced practice. Using sheep for mowing can help reduce pollution, maintenance costs, herbicide use, and fuel consumption. They contribute to holistic land management by controlling brush, weeds and invasive plants while restoring native grasslands. In addition, it has a huge awareness-raising potential. However, providing appropriate accommodation and veterinary costs and expertise, as well as finding a shepherd, can be challenging, and most likely, you might meet several regulations, too. A good communication campaign is also needed.

IMPROVING BIODIVERSITY IN PRIVATE LANDS

WHAT IS BEAUTY?



*An award-winning biodiverse private garden
© Hegyvidék Önkormányzata*

Very often, the most urban green area is owned privately. It is thus crucial to engage residents and local companies, nurturing them to more pro-environmental behaviours and using more biodiversity-inclusive approaches in their gardens, making them more resilient to the negative impacts of climate change too.

There are plenty of tools to activate private owners to transform their private gardens into biodiversity oases; however, very few municipalities across Europe have a systematic approach for that. In the BiodiverCity network, we analysed the case of the Municipality of the 12th District (Hegyvidék) of Budapest, one of Budapest's greenest districts. It has not only lots of green spaces, but it also provides protected habitats for rare, endangered and even endemic species. Hegyvidék has a huge responsibility to maintain the greenery, to properly communicate with the residents and to raise their awareness of environmental issues. The Green Office was established in 2016 as one of the departments of the municipality that has several roles to address the needs of the residents and to develop the district's sustainability further. The Green Office has a massive, ever-growing Residential Programme, which was analysed by the BiodiverCity partnership within a case study and summed up below.



Provide a free-of-charge branch-cutting service!

Based on preliminary registration, residents can get a free-of-charge service once a season to cut the fallen or removed branches (max. 10 m³) by a mobile cutting machine. There are strict rules for the preparation of the branches and provision of accessibility for the mobile machine, but the most important issue is that the municipality does not transport the mulch away; it has to be used in the garden for covering the soil or composting.



Provide composting boxes!

It is a key to reducing household waste, and if someone has a private garden, it would be "compulsory" to compost and not to waste the natural resources. Starting in 2008, the municipi-

pality has been providing simple composting boxes every autumn for private owners and institutions to foster pro-environmental behaviours. It is free of charge, but applicants must attend a short training session.



Promote fruit trees among residents – they are good for nature and more climate resistant!

Within the "Fruitful Hegyvidék" programme, the Green Office announces a discounted fruit tree sale for residents who are willing to plant and cultivate native fruit trees in their gardens. This will enable them to produce healthy fruit locally, but native fruit trees are also more climate-resistant than many ornamental trees and are also good for pollinators. Within the framework of the program, a maximum of 2 fruit tree saplings can be purchased per property at half price. With each purchased fruit tree, the Green Office provides a "Care Package" free of charge.



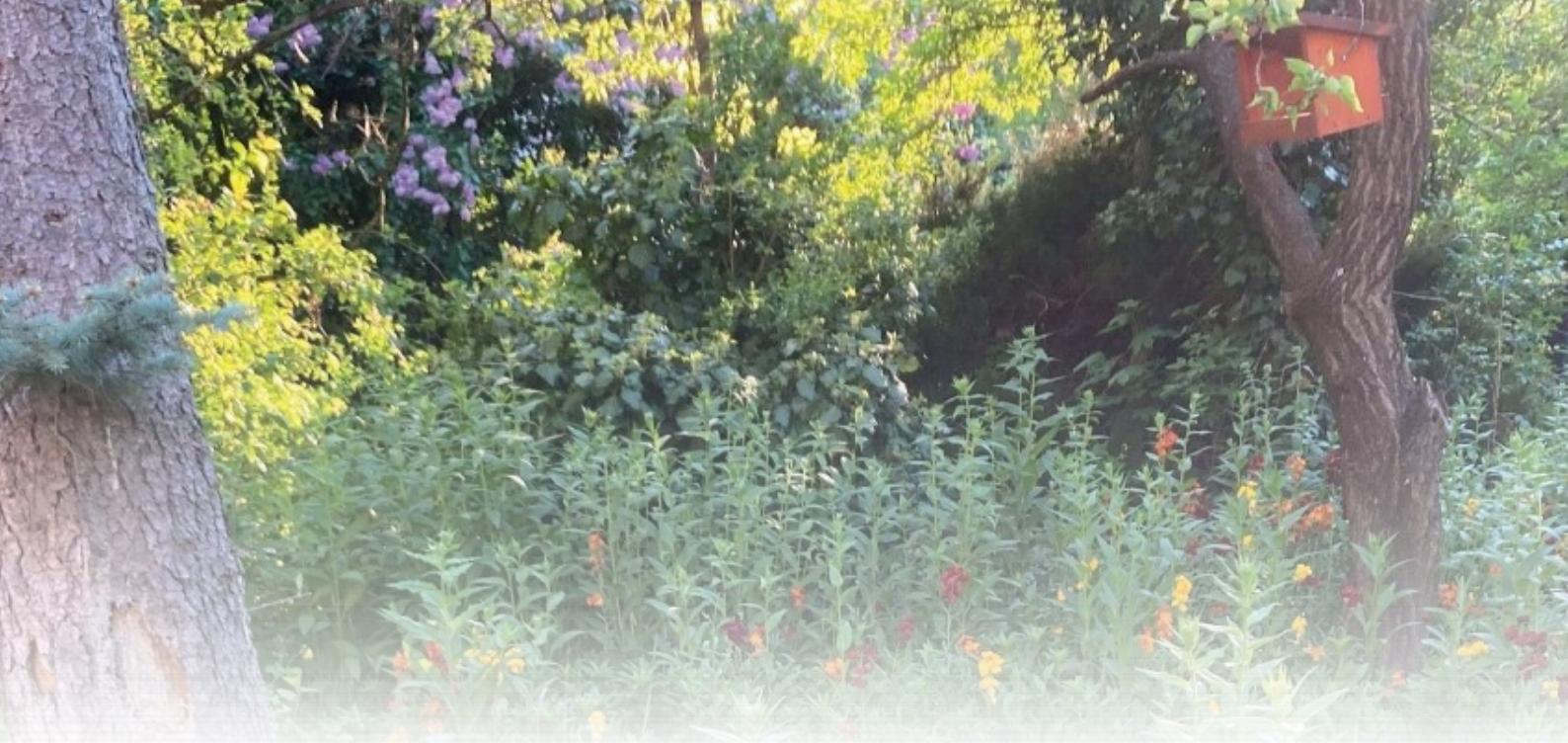
Distribute native trees among residents!

As part of the Shady Hillside Program, the Green Office regularly announces a free tree distribution for residents who are willing to plant native trees in their private gardens. This initiative aims to further green the gardens to provide shade as part of climate action. Within the framework of the program, a maximum of 4 free native bare-root saplings, each 1.5-1.8 meters tall, can be requested per property, regardless of its size. The Green Office also provides a planting and care guide along with the trees.



Organise a yearly competition and certification for nature-friendly gardens!

With the title of "Nature in My Garden", the Green Office yearly launches a competition for garden owners to showcase their gardens to a professional jury and, if the garden meets the criteria for a nature-friendly garden, to receive the "Nature in My Garden" award. Applications can be submitted continuously, but each year the jury checks applications received by 10 May. All gardens rated as nature-friendly will receive a "Nature in My Garden" plaque.



A biodiverse garden is always a bit chaotic
© James Atkins



Be a Bird-Friendly Garden!

In many countries, the local branch office of BirdLife International organises certificate programmes for gardens in cooperation with local authorities. Private gardens might get a certificate and plaque, the municipality can organise thematic walks, prepare guidelines (e.g. tips for feeding in wintertime) and presentations with experts, distribute birdhouses and birdfeeders for residents and have a bird-friendly model garden in one of the public parks.



Promote climate-tolerant, native, and pollinator-friendly flowers!

Besides changing the plantation methods in public areas (e.g. using perennials instead of annual flowers), your municipality might change the principle of the often-used flower distribution programme. The aim remains the same (helping residents, especially in the downtown area, to green and beautify homes, balconies, and gardens), but biodiversity is better promoted now by using biodiversity-related aspects within these running programs.



Support residents with tree pest control!

Climate change often causes an increased number of pests. While the municipalities can tackle

this issue directly in public areas, in such a green district, support is needed for residents to save endangered trees and raise awareness. The Green Office has thus launched a residential action to control the main pests of horse chestnut, plane, and oak trees. The support is available until the allocated budget is exhausted and is provided on a first-come, first-served basis. The support covers half of the costs, with the municipality covering 50% of the procedure costs (either the spraying during the second breeding season or half of the cost of a single injection).



Support residents in rainwater harvesting!

Private owners might have a crucial role in decreasing the amount of runoff water by installing water retention measures. In many European cities, municipalities give financial and thematic support to residents by installing raingardens, green roofs and vertical gardens. The Green Office has started to support rainwater management and utilisation on private properties. To this end, hundreds of rainwater collection kits (300-litre tank, tank lid, base, and tap) were provided to district residents at a discounted price (each property is eligible to receive one rainwater collection kit upon payment of a small self-contribution fee).



A small pond is inevitable in every biodiverse garden
© dr. András Grád



Raise awareness!

The Green Office regularly organises a series of events titled "Climate-Friendly Evenings". These events aim to provide engaging and high-quality leisure activities through scientifically rigorous yet popular lectures on climate change and climate adaptation for an audience interested in and eager to learn about environmental sustainability. In the frame of the above residential programmes, the Green Office also organises lots of thematic walks and other specific events, as well as publishes guidelines and books.



Promote gardening!

The Green Office also has a grant application for the establishment of raised garden beds in the courtyards of apartment buildings and housing cooperatives, to increase green spaces in more densely built-up areas of the district and raise awareness. This is a non-repayable monetary grant paid to applicants.

Last, but not least, it is worth mentioning that the Green Office regularly organises other "green" events and programs, not strictly related to urban green spaces (e.g. bicycle breakfast to promote green mobility, organised collection of used cooking oil at public schools, organised events to collect hazardous waste).

CREATING URBAN WILDLIFE AND GREEN CORRIDORS

*MICROHABITATS, PROTECTED AREAS,
AND QUALITY GREEN AREAS
AS BIODIVERSITY HOTSPOTS*



One of the green valleys
approaching the city centre in Siena
© Ferenc Albert Szigeti

Urban areas can even shelter important species (i.e., pollinators); therefore, conservation within urban areas can be essential for many species. In line with the ambitious EU Biodiversity Strategy for 2030 and the Nature Restoration Law, stopping and reversing biodiversity loss by promoting the systematic integration of healthy ecosystems, green infrastructure, and nature-based solutions into all forms of urban planning is the utmost priority. This is, of course, fully in line with the global developmental goals. Target 12. of the Kunming-Montreal Global Biodiversity Framework refers to urban green areas (Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity) as follows: *“significantly increase the area and quality and connectivity of, access to, and benefits from green and blue spaces in urban and densely populated areas sustainably, by mainstreaming the conservation and sustainable use of biodiversity, and ensure biodiversity-inclusive urban planning, enhancing native biodiversity, ecological connectivity and integrity, and improving human health and well-being and connection to nature and contributing to inclusive and sustainable urbanisation and the provision of ecosystem functions and services”*.

Ecological connectivity and integrity are key aspects in these definitions, and creating wildlife and green corridors for the benefit of both nature and people is therefore a crucial component of any urban strategy that tackles urban green and blue infrastructure and intends to increase urban biodiversity.

Green corridors are (linear) green spaces that can provide a range of connectivity services, including natural habitats and recreational path-

ways. Connecting urban green areas (public parks, private areas, tree alleys, etc.) can be effectively strengthened by creating microhabitats for different species (pollinator-friendly flowerbeds, wildflower meadows, ponds, etc.) in those areas where recreation is not the primary function. Wildlife corridors facilitate the movement of wildlife by connecting fragmented habitats, which improves population stability and biodiversity.

However, habitat fragments in urban landscapes are often divided by roads and scattered across multiple parcels owned by different individuals or organisations. In addition, property ownership within cities can change quickly. As a result, conservation recommendations that prioritise wildlife — such as maximising corridor width or completely excluding human activity — are often unrealistic in urban settings. Consequently, traditional wildlife corridors, like bridges linking two protected areas, may be insufficient for maintaining connectivity within cities.

Yet, establishing priority areas for urban wildlife corridors, where efforts are coordinated to preserve multiple pathways of connectivity, can be realistic to facilitate conservation in urban areas. For that, cities must use a combination of approaches, including green infrastructure, habitat restoration of private lands, conservation partnerships, and, if needed, acquisition of lands. Of course, land acquisition makes the process significantly more difficult; improving the quality of existing green spaces to better support conservation goals by biodiversity-inclusive approaches (e.g. micro-habitats, climate-resilient grassland management) is often more realistic.



A rural landscape in the Pecci Garden, a few meters from the Piazza del Campo
© Ferenc Albert Szigeti

The case of the “other” (the unknown, green) Siena

Explore the case of Siena, where five green valleys, as a legacy of the city-state, medieval wealth and self-sustainability, radially approach the very dense historic centre, built on a plateau, bringing the countryside just next to the main square. These green valleys are like mementoes of history: the medieval town is still connected to the countryside through them, which was an essential part of the local identity over the centuries in the Siena city-state, where self-sustainability was very important. These valleys are partly abandoned today as farmers stopped their activities in the 1960s, and at the same time, many people moved out of the historical centre. In recent years, enthusiastic NGOs and ecologists rediscovered some of these valleys, fragmented by roads and neighbourhoods, and they are jointly rethinking their future with the municipality along biodiversity goals.

Siena has elaborated a plan to create a green corridor, and the first steps have already been made in the Ravacciano Valley, where a lot of different initiatives have been running. The first step was made in 2014 within the participation process provided by the Common Goods Regulation. The valley, first and foremost, gives

home to the Busseto Woods: a secondary vegetation that grew when locals stopped agriculture here. A few years ago, local volunteers, coordinated by WWF Siena and Legambiente Siena, cleaned up the forest, and the plan is to make Busseto Woods into an open-air classroom, with local greenways, a nursery of endemic species, etc.

The Ravacciano neighbourhood and the valley were the target area of the H2020 project URBiNAT. The whole neighbourhood was involved in co-designing nature-based solutions in the area; therefore, the valley is the home of several projects focusing on nature. Some pioneer initiatives have already taken place, such as the small wooden house with a separate beehive, providing apitherapy, the creation of an urban community garden (one of the 5 within the city and 80 (!) in Tuscany), the creation of public paths and connections, and wildflower meadows and fruit forest for pollinators. The biodiversity of the area was highlighted by the organisation of a bioblitz event within the City Nature Challenge in 2022.

The next step was the elaboration of the ConVerSi green corridor strategy Siena (2021-2023), scaling up the participatory regeneration model tested in the Ravacciano Valley to the urban level. The project aimed to enhance urban redevelopment and socio-cultural regeneration of various green areas in the city connected to the city walls. It targets the wall system (approximately 7 km in total with seven gates and several passageways, towers, fortifications, etc.), the system of green valleys inside and outside the city walls as well as cultural heritage (Medici Fortress, S. Marco Complex, Villa Rubini, the Lizza Gardens), and includes various local stakeholders (owners of the walls and green valleys; institutions, districts, associations, citizens, schools, etc.).

The plan builds on this magnificent socio-cultural heritage and the active communities committed to caring for common goods, which is still recognisable as the Regulation of Common Goods, resulting in the launch of collaboration agreements with various groups (Le Mura Association, RigenerarSI project, Boschetto San Miniato, Rete degli Orti di Siena).

Besides increasing biodiversity, the plan prepared within the ConVerSi project in 2024 aims at connecting neighbourhoods through the creation of pedestrian and cycling routes, forming a basis for a wider green corridor in the future, and recommends various project solutions (street furniture, paving, lighting, vegetation, building works, accessibility, signage, etc.).

Youngsters prepare for the Palio in one of the green valleys
© Ferenc Albert Szigeti





BiodiverCity field visit at the Ravacciano Valley, Siena
© Ferenc Albert Szigeti

Fundamental questions every city shall address to ensure effective wildlife and green corridor restoration



What potential exists in your area?

Begin by working with researchers and ecologists to assess the potential for wildlife or green corridors in your city. Which areas could be connected, and which species could benefit? Are you linking only parks, tree alleys, and wildflower beds, or can you also incorporate more natural or protected areas with greater potential for supporting mammals and other wildlife? This assessment will also guide stakeholder engagement, ranging from residents and park maintenance teams to national park administrations.



A long-term “conservation area” plan defining priority areas for an urban wildlife corridor

Once possibilities are clarified and there is political will, you need a good plan to establish priority areas for city or region-wide connectivity. Do you need a new plan, or does your green infrastructure plan include a long-term vision for creating a green corridor, including aspects and tools to increase biodiversity?



How will you assess urban wildlife corridors?

Establish a database to research and monitor connectivity. Use diverse scientific tools — such as remote-triggered camera traps, community science contributions (e.g. bioblitz events), and field monitoring by researchers — to track wildlife presence within priority areas.



What is the status of the land parcels involved?

Gather detailed information on parcel boundaries, ownership, and publicly held lands. After identifying priority areas on maps, complement wildlife data with on-the-ground assessments: walk potential routes, evaluate habitat quality (availability of resources like food and water, levels of pollution), and identify both conduits (e.g., underpasses, channels) and barriers (e.g., fences, roads, buildings) to movement. Rank parcels according to their suitability for conservation goals.



Is land acquisition necessary for connectivity?

Compare all vacant and privately owned parcels in the target area to prioritise conservation needs. Use these findings to make evidence-based decisions about purchasing land to preserve and restore connections.



How will you restore and manage the corridor?

Support restoration by initiating diverse actions, from distributing native plants to residents to or-

ganising volunteer-driven habitat restoration projects.



How will you foster collaboration and community engagement?

Develop outreach and education programs to share research results and inspire residents to participate in protecting urban wildlife.

*An experimental wildflower bed in Siena
© Ferenc Albert Szigeti*



THE POLLINATOR-FRIENDLY CITY

BEE RESPONSIBLE!



*A beehive therapy house in Poljčane
© Ferenc Albert Szigeti*

Urban areas, sadly, have become key in halting the decrease in the number of pollinators caused mainly by intensive agriculture. Believe it or not, the honey produced in urban areas often has very high quality since there is a very diverse vegetation, where the use of chemicals is far less significant! In urban green areas, we can support pollinators in many ways, and indeed, hundreds of European cities have been experimenting with pollinator-friendly initiatives. Let's see the main features of a well-structured pollinator support programme!

The easiest and cheapest tool is to change the approach to green space management: decrease mowing frequency, especially in less-used green spaces. It not only provides havens for pollinators (and thus increases biodiversity) but also contributes to cooler surface temperatures compared to regularly trimmed lawns, better water retention, a more beautiful streetscape, and even positively impacts the local groundwater balance. We can support this process by using seeds of native species to enrich urban wildflower meadows.

Create bee pastures! These are artificially flowered areas by using a special seed mix of native species, resulting in areas that flower during the summer, where there is less food for pollinators. Almond-lavender gardens are also great magnets for pollinators.

Manage urban green spaces in an ecologically way and create a local pollinator-friendly stakeholder group. In Budapest, for example, the Metropolitan Waterworks have large water protection areas, fenced for decades. Initiated by the Municipality of District 12, the company now cuts the grass only once or twice at the end of summer, instead of regular mowing. These areas have become wildflower meadows.

Use shrubs in parks and incentivise residents to plant species on fences, for example, like ivy, which is an important food for pollinators in the autumn.

Experiment with **installing bee hives** in public areas. It might sound dangerous to many city leaders, but cities are often full of green corners

nobody uses. Urban beekeeping has the power to enhance pollination for city gardens and parks, leading to increased plant growth and biodiversity. This practice offers valuable educational opportunities for residents to learn about the essential role of pollinators in ecosystems. Specially designed bee hives are perfectly suited for urban settings, promoting community engagement and yielding delicious local honey. Ljubljana has even included its related activity to tourism: BeePath is a publicly available track connecting accessible places of urban bee-keeping.

Have a broad education and awareness-raising program, including elements like, for example, "Our Bees" program series at the local cultural centre, honey breakfasts in kindergartens and primary schools, bee-friendly educational programs for open events, installation of insect hotels, professional lectures and walks for adults, and publications, creation of a demonstration hive and organisation of community beekeeping events.

Engage residents not only by inviting them to join the local pollinator-friendly network but also by involving them in programs that have been fine-tuned along the principles of the pollinator-friendly city concept (e.g. the distribution of native fruit trees and seeds for bee-pastures), allowing them to actively participate in the network.

Create a thematic walk in the city, connecting interesting sites both regarding pollinators and local cultural-natural values.

Promote a healthy, eco-friendly lifestyle that encompasses everything from pollinator-friendly gardening to the rejuvenating power of nature, from consuming beekeeping products to close cooperation with nature (e.g. promoting products made by network members; a competition to support and reward the creation of nature-friendly gardens - "Nature in Our Gardens").

Engage residents through beehive therapy! Engaging residents is an evergreen challenge in these sensitive, often culturally-driven questions. For them, operating a beehive therapy



*BiodiverCity study visit in Poljčane
© Ferenc Albert Szigeti*

house in a controlled way can be an interesting and rather attractive engagement tool, getting people closer to nature. The Beehive Therapy House is a tiny wooden house, accessible in a safe way from one side, while the opposite side gives home to dozens of beehives. Beehives are “open” towards the house as well through a very dense net, so bees cannot enter the house, but the air of the beehive can circulate indoors. The beehive therapy is twofold. You can enjoy the highly ionised and clean air of the beehive. This air is free of bacteria, viruses and pathogenic fungi and thus has been shown to benefit the lungs and respiratory system, as well as has a calming effect on the mind. The other issue is vibration: bees use their wings to fly, create heat, and generate acoustical signals. Scientists say that a hive produces frequencies ranging from less than 10 Hz to more than 1000 Hz, and this

vibration works like a “sound massage”, having positive effects on our nervous system and reducing stress and tension. Beehive therapy is about visiting the hut regularly to inhale and relax (it is even possible to spend the night in the hut), and the therapy has many positive effects on our bodies. Together with the classical forms of apitherapy, it can help with e.g. insomnia, diseases of the nervous system, rheumatic diseases, respiratory diseases, chronic headaches, states of depression and stress, allergies, and strengthening the immune system.

Read our [full article](#) on Beehive Therapy BiodiverCity partnership experienced in Poljčane, Slovenia, where apitherapy, the use of bee products including honey, pollen, bee bread, propolis, royal jelly, beeswax, bee venom and larval bees was born.

BEYOND BIRDHOUSES

*WHAT IS A
BIRD- AND BAT-FRIENDLY CITY LIKE?*



*Red kite nesting on the 10th floor in Budapest
© Zoltán Orbán*

"Loud by birdsong." Almost every property advertisement in a green neighbourhood begins like this – thus, birds are worth millions of euros in a city. Birds have particular attention among the animal kingdom and are therefore given a special role in nature conservation. This is not just because of their wonderful singing voices or their airy flight, which humans have always longed for. Birds are indicators of biological diversity, and changes in their populations and behaviour signal the natural condition of their habitat.

Settlements offer numerous advantages for birds (e.g., favourable microclimate, water, fruit trees, ornamental trees bearing edible fruits and seeds), which encourages certain species to settle permanently, a trend that is only reinforced by climate change, and municipalities can support birds through a whole range of activities. This is summed up below.

There are well-known, urbanised species, there are cosmopolitan species that are widespread throughout the world, and are well adapted to the urban environment, but can also be found in nature (e.g., peregrine falcons, starlings, blackbirds), and there are species that avoid humans, but some of them regularly appear in larger urban green spaces, for example in winter. Suburbs act as a stepping stone between nature and settlements, which is partly responsible for

the urbanisation of animals. The advantages offered by the urban environment attract additional migratory birds from the north to settlements in winter. The urban environment can also change the behaviour of birds: some species sing louder, while others lose their migratory instinct (e.g., blackbirds and robins). At the same time, cities are dangerous for birds too: the overly "sterile" and orderly urban environment does not provide enough food or nesting sites, and the indiscriminate use of pesticides, which is particularly prevalent in cities, causes enormous ecological damage.

Transparent, non-reflective glass surfaces, or those that reflect the natural environment, are also a major source of danger, as they appear to be open space to birds, resulting in the death of millions of birds each year. Electrocution primarily affects larger birds, whose wingspan is large enough to simultaneously touch dangerous wires and pole elements. Pets, especially cats, pose a much bigger problem: even by conservative estimates, around 20-30 million (!) birds are killed each year by cats in Hungary. However, while some bird species are particularly well adapted to human presence and are expanding, according to BirdLife International, one in five of the 10,966 bird species found worldwide requires effective conservation measures.



Blackbird on hackberry in Budapest, Népliget

© Zoltán Orbán

Where there are many birds, life is good. What can a municipality do to protect birds?

The most important thing, of course, is to **strengthen nature conservation through municipal regulations** and to prioritise bird and nature conservation in the legislative processes. The enormous and unnatural predatory pressure exerted by cats, for example, could be reduced by requiring the neutering of animals.

Ideally, local authorities should **support and involve local communities in decision-making** (the involvement of farmers and civil society organisations is particularly important in the case of birds).

Bird-friendly local authorities **ecologically manage their green spaces**: they maintain a diverse tree population, rich shrubbery in parks, and, except for recreational areas, insect-friendly wildflower meadows. Wherever possible, it leaves dead wood in place, uses as few pesticides as possible, and only cuts and prunes trees outside the breeding season.

The **planting of plants that are a source of food for birds** in public areas is also particularly beneficial for birds (e.g., single-seeded hawthorn, black elderberry, firethorn, ivy, blackthorn, wild grapevine).

Local authorities committed to urban biodiversity use **bird-friendly solutions on their own properties** and wherever possible. For example, there is plenty of space on the walls of residential buildings or under balconies for installing artificial swallow nests, house martin boxes, sparrow nesting boxes, other nesting boxes and bat boxes, and this does not cause any conflict. Of course, it is best if the local government requires a zoological survey before starting renovations and insulation work, as residents are typically unaware that martins are nesting or bats are raising their young in their buildings.

In relation to buildings, it is also important to professionally **open tent roofs and church towers**, which allows barn owls and bats to settle, but pigeons cannot occupy them in this case.

Many people use silhouettes of birds of prey that can be stuck to windows, which can be a solution, especially if they are modelled after real birds of prey and can move by the wind, but in many cases, birds get used to these tricks.

However, thanks to biomimicry, a scientific discipline that imitates nature, it is now possible to purchase spider web-patterned glass (since birds do not fly into spider webs) that is transparent to the human eye but contains a pattern that reflects UV light, making it visible to birds.

And then, of course, there is the eternal question of **changing public attitudes**, from placing birdhouses in gardens and school programs to bird feeding and nature walks to bird-friendly model gardens. In a bird-friendly community, as many gardens as possible are bird-friendly, slightly untidy and overgrown, but biologically diverse.

Domestic cat at a birdhouse in Budapest
© Zoltán Orbán



GREEN SCHOOLYARDS

CLIMATE REFUGES FOR ALL



*School in Paris, at Emeriau street
© CAUE, Guillaume Bontemps*

“Look, a schoolyard without trees, where most of the surface is paved by concrete, is more like a prison and not like a place for having fun”, says Miguel Ángel Piñera Salmerón, officer of the Municipality of Cieza. This BiodiverCity partner has started to transform one of the municipal school-yards.

Paris is leading the way in Europe in the transformation of schoolyards, where heat waves in recent decades have claimed many lives (research by the French public health agency links 30,000 to 35,000 deaths nationwide caused by heat waves between 2014 and 2022); however, this is obviously related to the city's dense population, which is 6 m² per person. The experiment began in 2020 with 10 schools, and today 164 of Paris's 745 schools have been transformed into green oases, many of which are open on weekends and during heat waves to residents, especially the elderly, and to some extent to homeless people as well. In addition to greening, rainwater retention, biodiversity enhancement, and the use of natural play equipment are also important considerations in the design of the gardens, in which students are actively involved. The municipality wants to completely remove approximately 73 hectares of asphalt from 745 schools in the coming years to reduce the urban heat island effect and create a healthy learning environment, which will also serve as a forum for environmental education and discourse on climate change.

The picture is even more complex, and biodiversity is not just a nice-to-have policy here. Very often, the soil of a schoolyard is contaminated with construction debris, severely degraded, poorly drained, the level of humus is very low, and the species-poor tree population is also in poor condition. The microclimate of the courtyard is often unfavourable, which is particularly important since trees and bushes of the schoolyard should also often protect children from the very significant air and noise pollution coming from busy roads nearby. 97% of European residents breathe air that doesn't meet World Health Organisation (WHO) standards, but schools are often located along busy roads. Thus, school children are often exposed to extreme levels of harmful pollutants, while, due to their age, they are especially vulnerable to these pollutants (e.g. their shorter stature and higher breathing rates expose them to greater concentrations of vehicle emissions).

Creating green oases in schoolyards often requires active participation of both students, teachers and parents, and the improvement of the soil is crucial. A multi-level plant community along the fence is also important, while a pollinator- and bird-friendly garden and rainwater harvesting is perhaps more about environmental education.

Read more about the [Paris Oasis Schoolyard Programme](#), transforming schoolyards into green spaces accessible to vulnerable groups to address heatwave vulnerabilities.

CONTROLLING INVASIVE ALIEN SPECIES

*FIGHTING WITH
THE ENEMIES OF BIODIVERSITY*



A riverbank ruled massively by Arundo donax (Cieza)
© Ferenc Albert Szigeti

Every single biodiversity office in all corners of Europe will spend significant time and energy mapping invasive alien species, drafting and yearly updating action plans to exterminate and control them, as well as raising awareness of the importance of this issue.

Invasive alien species have been identified across Europe as a major threat to biodiversity, ecosystems, habitats and native species. They are often impossible to eradicate because they are difficult to control and contain. A biodiversity action plan or an invasive species management plan must consist of tasks related to prevention through education, inspection of equipment and goods to stop new introductions, early detection and rapid response to remove new invasions quickly, and control and management of established populations using methods like mechanical removal, biological control (introducing natural predators), and restoring native habitats. Supporting residents in using native plants in gardens and encouraging restrictive legislation against the sale of invasive species also helps re-

duce the spread of invasive alien species and their impact on local ecosystems.

In such an action plan, consideration must be given to the fact that controlling invasive alien species is only efficient over a long-term period; therefore, multi-annual funding is required.

In addition, citizen science might play an important role in mapping invasive species, but it also enables residents to be more alert to them. For instance, Guimarães, among the BiodiverCity partners, has experiments not only with using a locally developed app to collect information about local biodiversity, but also with new methods to push back these species. On Penha Mountain, for example, there is a pilot area where the municipality removed not only the local population of Japanese knotweed (*Fallopia japonica*) but the sediments too, then they laid down a biodegradable mesh and planted native vegetation on it to stop the presence of *Fallopia japonica* in a valuable oak forest.

*A pilot area in an oak forest (Guimarães) where the population of the Japanese knotweed (*Fallopia japonica*) was removed with the sediments, and a biodegradable mesh was laid down for the planted native vegetation.*

© Ferenc Albert Szigeti



AWARENESS-RAISING, ENGAGEMENT AND ENVIRONMENTAL EDUCATION

*THE GLUE OF ALL
URBAN BIODIVERSITY ACTIONS*



Community garden in Guimaraes
© Ferenc Albert Szigeti



River restoration demonstration area next to the Landscape Laboratory in Guimaraes

© Ferenc Albert Szigeti

Green space stimulates identity and community spirit efficiently; therefore, they are great tools to mobilise citizens. This is important as cities can address the impacts of an ecological crisis 1. by changing their physical infrastructures and service systems, and 2. as the most local forms of

governance, by changing the attitudes of their residents. New, biodiversity-driven green spaces might be advocates of the mindset change required. Activating local communities along the values of biodiversity is therefore a key task for any municipality.

The case of Guimarães, the European Green Capital in 2026

“The best thing we have made in Guimarães so far related to green urban spaces is the establishment of the greenways. Greenways bring people back to nature, and people using nature start acting as “spies”. We made the greenways mostly along the rivers, where landowners had to permit it and - in most cases - give a piece of their land where the track is placed now. If the municipality asks it from landowners, they – most likely - say no, but for the Green Brigades, they said yes,” says José Fonseca, the coordinator of the best performing Green Brigade of Guimarães in 2024. The so-called Green Brigades have been operating since 2015. Now they are active in 38 parishes (out of 48 parishes in total), covering 70% of the territory of the municipality. This initiative, unique in Portugal, can efficiently stimulate local identity, make the participants proud and satisfied, and provide visibility and

training opportunities for participants. Volunteers of Green Brigades have made hundreds of environmental community actions.

“So, what is the secret behind the high level of engagement in Guimarães?” curious participants asked José during the BiodiverCity study visit.

“The secret is the continuity. I have been volunteering for 10 years now...”

The result is manifested in national and European recognition: Guimarães has been recognised three times as the most sustainable city in Portugal, and since 2018, it has been coordinating the Working Group Green Areas and Biodiversity at Eurocities. Guimarães is proud to be a signatory of the Green City Accord, a European initiative committed to creating cleaner, healthier, and more sustainable urban

environments and works on its [City Biodiversity Index](#). And most importantly, after several attempts, Guimarães is the European Green Capital in 2026.

Behind this great success, Guimarães's effort to raise awareness, engagement and environmental education is definitely a key component. In 2014, Guimarães created a strategic plan which protects and promotes biodiversity in urban areas. The plan emphasises the importance of native species and fosters environmental education, citizen science and engagement through strong leadership. In 2014, the Guimarães City Council, the University of Minho and the University of Trás-os-Montes and Alto Douro established the [Landscape Laboratory](#), a centre for environmental research and education, focusing on three main areas of intervention: research and education, project management and communication and environmental training.

One of the flagship projects, the Pegadas city-wide environmental education initiative, started in 2015. This program includes multiple activities related to urban biodiversity, enhancing awareness mostly with younger generations (reaching 83 schools and 20.000 students across 48 parishes through more than 900 activities organised per year, including the training of teachers). It also targets the general public through the organisation of bioblitz events, workshops, and festivals like the Green Week, where young influencers help with the work of the Landscape Laboratory. Since 2008, the city has also had a growing community garden, now operating on 3 hectares, and it is a great asset for raising awareness.

Read the full [case study](#) on how biodiversity becomes a core organising principle of urban development in Guimarães, Europe's Green Capital 2026.

*Presentation by José Fonseca during the BiodiverCity study visit
© Ferenc Albert Szigeti*





Macrophyia ribis - a new species spotted in Siena by the Portuguese partner of BiodiverCity

© Daniel Ferreira

Bioblitz: an engagement tool directly focusing on urban biodiversity

Bioblitz is a great tool using citizen science to activate and raise awareness of local communities, along with biodiversity. According to [National Geographic](#), it is an event that focuses on finding and identifying as many species as possible in a specific area over a short period, usually 24 hours. A bioblitz brings together volunteer scientists, as well as families, students, teachers, and other members of the community. While a scientific survey often focuses on unique or isolated areas, bioblitzes usually focus on urban green areas.

The bioblitz, as a unique biological survey, encourages a relationship between the natural and human communities since citizens work alongside scientists to learn about the biological diversity of local natural spaces. In the process, they gain skills and knowledge and develop a stronger connection to their home environment. A bioblitz aims to promote and improve local natural spaces by empowering citizens to better understand and protect biodiversity.

The first bioblitz was sponsored by the National Park Service and the National Biological Service in Washington, D.C.'s Kenilworth Park and Aquatic Gardens in 1996. Surrounded by heavy

residential and industrial development, Kenilworth Park was thought to have very little biological diversity. Scientists, however, tallied more than 900 species that first year and added even more species to their list at successive Kenilworth bioblitzes. Hundreds of bioblitzes have been conducted all over the world, primarily in the United States, Canada, Australia, the United Kingdom, and Europe and through the [City Nature Challenge](#), bioblitz has become an international activity.

How to organise a bioblitz?



A contest or a game? Every bioblitz is a friendly and flexible “contest” since an urban area cannot compete with a natural area in terms of the number of species, while it is much easier to involve more people in cities than in a natural park. It is a citizen science as well as an awareness-raising tool.



Timeframe: it is usually organised within 24 hours (however, it might be important to plan an option B in case of rain, for instance).



Location: it is not necessarily the entire city, it can be a neighbourhood, a park, or another green area, and it can be changed year by year.



Observation and validation of records: most often, organisers use the easy-to-use and free-of-charge app iNaturalist (available in various languages). Different invited experts guide and help citizens in observations, and later on, validate the records.



Logistics: a bioblitz can be a great community action, but it requires some additional organisation. You will need volun-

teers who help scientists and community members take inventory at a bioblitz. Depending on the location and the size of the community event you plan, along with the bioblitz, you might think about the organisation of education programs on the spot, traffic/parking control, information stations, registration, delivering food to staff, shuttling supplies, technology support staff, set-up and take down, facility management help, and security.

Read the [experiences of Siena](#) on how to organise an efficient bioblitz event to map urban biodiversity and activate local communities.

Bioblitz in Siena
© Municipality of Siena





In the Urban Sensory Garden, Sarajevo, another URBACT good practice

© Ferenc Albert Szigeti

Bringing people to nature to enable them to plan nature-positive public spaces / The Sarajevo Process

One of the tools the partnership learnt about is the so-called Sarajevo Process: a co-creative arts-based engagement approach (partly) developed in Sarajevo by Trinity College Dublin and the University of East London in the frame of a Horizon project.

Putting it simply: it is about inviting participants (residents) to nature, to get a direct connection to ecosystems in a facilitated way and using storytelling about their nature experience to co-create valuable urban green spaces and nature-based solutions.

According to the website, the process enables stakeholders in cities to: 1. tell the story of nature/NbS in their cities; 2. engage with citizens to tell their stories, and use these stories to help frame the co-creation process for NbS; 3. design NbS to address a particular challenge in a city. Sarajevo, as a developing city facing many typical, burning urban challenges and surrounded by magnificent nature, indeed provides a great opportunity to test this method, and the city's international atmosphere can further support the process.



Field visit at the Natural Play Area (Limerick)

© Ferenc Albert Szigeti

Get to know Ireland's first Natural Play Area!

Another great tool to engage residents, especially children, is the elaboration of a Natural Play Area, BiodiverCity partner Limerick first created in Ireland in 2022 at the Castletroy Urban Greenway, within the Go Green Routes Horizon 2020 project, and which has been selected as a URBACT Good Practice.

Limerick City and County Council created the Natural Play Area for an urban greenway incorporating nature-based solutions (e.g. rain gardens, wildflower meadows) and recycled felled trees. The redesigned area along a new housing estate facilitates connection with nature and allows for passive surveillance. Existing dead trees were recycled into play equipment, seating, insect hotels or mulch covering the ground. Small mounds created are covered by local wildflowers, while among the mounds and along the pathway, raingardens are located at low points. Play equipment, created from salvaged trees, connects mounds and creates a wide variety of informal play opportunities, allowing children to sit on, climb on or walk on as they play. A fence planted with native woodland plants will provide good screening from the neighbouring sports pitches.

Limerick City & County Council intends to use this model in the future, where possible, because it encourages children to engage more with nature and their natural surroundings. It is not a formal playground, thus less strict regulation applies, but indeed a great place to get some of our connection to nature back. “A good way to encourage people to explore urban green areas”, as one of the BiodiverCity participants summed up.

It is possible to further develop the idea along the philosophy of the so-called motor activities park (motorik parks), making these areas more attractive for kids and families. The motor activities park encourages physical and mental fitness with specially designed or simply natural equipment that is suitable for all ages and fitness levels. The motor activities park provides both children and adults with the opportunity to train balance, coordination, strength and fitness whilst recharging their energy levels. Balancing activities accelerate the motor and intellectual development of children. The motor skill park turns balance training into fun play.



*BiodiverCity partners at a Jane Jacobs Walk in Cieza
© Ferenc Albert Szigeti*

Walks and Talks and Art

Many cities around the world are experimenting with how to communicate about the benefits of urban green spaces. Hereby, there are some interesting methods:



Communication about the benefits of trees. These campaigns vary from simple actions such as placing meaningful messages on trees about their benefits, incl. monetising them, to more complex projects. Cities often use their tree registries to highlight the ecosystem services urban trees provide. They create a dedicated website or app not only to describe the species, genus and family of the given tree but to share myths, cultural and historical values, as well as to highlight benefits, for example, yearly (e.g. oxygen produced, carbon dioxide reduced, stormwater intercepted, energy conserved, air pollutants removed, total value of the tree).



We are witnessing the renaissance of thematic and urban walks. This can be led by experts talking about the values of urban green areas, such as forest bathing exercise or community-led walks

such as the Jane Jacobs Walk, experienced by the BiodiverCity partnership in Cieza or urban trekking, initiated by Siena in 2006.



Use storytelling and oral history to celebrate urban greenery! Residents and communities have great stories about urban greenery, too – compile them into online collections and galleries. Australian cities are creating “soundtrails”, the stories of greenery collected can be a part of a tree festival or urban stories festival focusing (partly) on greenery. Oral history was used, for example, in the Netherlands: learning about how locals used to live together with flooding is key to investigating how nature-based solutions can be implemented to retain water in the landscape. The Dutch partner city, Den Bosch, has plenty of different guided audio tours that have been developed by volunteers and enthusiasts. These guided walks can be linked to natural heritage, too.



Use community art for community actions in greenery. Copenhagen-based Thomas Dambo is a great source of inspiration. Since 2006, he has made and installed more than 3500 birdhouses, in different shapes and colours, all over the world. This is the Happy City Birds project. All birdhouses are made from recycled materials and scrap wood. But Thomas is more famous for his “giants”, huge wooden sculptures created based on legends and made from recycled materials and trash. These are great tools to generate local tourism, but the main goal is to raise awareness of recy-

cling and reuse; thus, such a project can be linked to urban greenery as well.



Organise competitions! Tallinn, as the European Green Capital in 2023, invited its residents to actively participate in different green capital competitions regarding Tallinn’s nature, urban space or any other green aspect. Besides widely known garden competitions, they organised environmental research competitions, environmental video competitions, creative projects competitions and speech competitions.

Måne Mor Troll #100 in Hedeland, Høje Taastrup, Denmark
© Thomas Dambo



URBAN BIODIVERSITY STRATEGIES AND THE ESTABLISHMENT OF A BIODIVERSITY OFFICER



Everything starts with a vision and political leadership at a municipality. In Guimarães, the European Green Capital 2026, for example, the story started with a vision of the current mayor back at the beginning of the 2010s after the city was awarded the European Capital of Culture (2012) and the European City of Sports (2013). Green issues and especially biodiversity became an integral approach and core organising principle in city development at that time, and have been systematically built into all relevant urban planning documents so far.

Another great example is Limerick, the Green Leaf City. Preparing for the 2020 Green Leaf Award (the city's commitment to better environ-

mental outcomes was awarded by the competition aimed at cities and towns across Europe, with populations between 20,000 and 100,000 inhabitants) inspired Limerick City and County Council to make a Green and Blue Infrastructure Strategy (GBI, 2023). It includes a range of actions to work with communities to contribute towards opportunities to conserve and enhance biodiversity and inform policy. It sets the scene for several new policies targeting green infrastructure (e.g. specifically dedicated to trees) and biodiversity.

Let's see what lessons these two examples provide us!

Learning about biodiversity-inclusive park maintenance in Limerick
© Limerick City and County Council





© Limerick City and County Council

A strategic plan around urban biodiversity is a must

Along with the establishment of the Landscape Laboratory in Guimarães, another initial action dedicated to the protection of biodiversity was a strategic plan which protects and promotes biodiversity in urban areas. The plan emphasised the importance of native species and fostered environmental education, the use of citizen science and engagement through strong leadership. Later, it was also recognised as a European-level good practice by the URBACT Programme.

The Biodiversity Action Plan prepared in 2023 based on the above-mentioned strategic plan, and the work of the Landscape Laboratory describes the key topics linked to urban biodiversity: mapping biodiversity including the use of citizen science, environmental education, fight against alien species, creation of green corridors, valorisation of natural routes, promotion of species observation, improvement of nature tourism, awareness raising, helping and nudging companies, individuals, and the public sector to minimise their ecological impact. The Landscape Laboratory has 5 thematic focuses: 1. biodiversity and water resources, 2. green areas and land use, 3. circular economy, 4. climate, and 5. health and well-being.

Limerick's GBI strategy aims to guide the urban planning and management process of multi-functional green and blue spaces, helping drive the transition to a low-carbon society and forming a cornerstone of sustainable development. It is not a 'must have' paper - it tackles local and global scale challenges, offering multiple economic, social and environmental benefits.

It is not limited to traditional green spaces such as parks, but it targets all types of green and blue areas. The GBI Strategy explains the benefits that natural assets can deliver to residents, visitors and the entire ecosystem (linked to both physical and mental well-being). It aims to make a corridor connecting green and blue areas (this Blue Green Ring around Limerick is Ireland's first city-scale planning and ecosystems enhancement programme), and besides the creation of high-quality, attractive, and functional places, it targets the negative impact of habitat loss and climate change at the same time.

The evidence base for the multi-functional benefits of GBI is constantly evolving; thus, besides the benefits for biodiversity, climate change and health, the GBI Strategy targets ben-

efits for the economy as well. In line with this, Limerick's GBI strategy focuses on four key challenges and identifies four spaces (overlapping each other):

- 1 Health Challenge - Improving health and well-being outcomes – creation of 'Healthy Spaces'
- 2 Climate Challenge - Climate adaptation – creation of 'Resilient Spaces'
- 3 Biodiversity Challenge - Ecological improvements – creation of 'Wilder Spaces'
- 4 Economic Challenge - Recreation, income generation and regeneration – the creation of 'Destination Spaces'.

By aiming to increase the use of nature-based solutions throughout Limerick, including urban greening interventions such as green roofs/walls and sustainable drainage systems, the GBI Strategy is incorporated into the Local Authority Climate Action Plan and in line with the Development Plan 2022-2028. Its 10 priority actions highlight well the core themes behind green and blue infrastructure as well as nature-based solutions in the urban context.

- 1 Embed GBI in the implementation of public and private projects.

- 2 Enhance existing open space provision within the area.
- 3 Create new formal parks and natural & seminatural parks to improve accessibility for a growing population.
- 4 Protect, value and enhance amenity green space by applying an appropriate management approach.
- 5 Enhance, protect and develop the network of blue-ways.
- 6 Integrate GBI in the delivery of the network of active travel routes.
- 7 Enhance recreational access to the local river and tributaries.
- 8 Develop Tree and Biodiversity Strategies for the area.
- 9 Promote community engagement and raise public awareness in the development of GBI.
- 10 Incorporate smart mechanisms of connecting GBI initiatives with the public.

Read the full [case study](#) on how biodiversity becomes a core organising principle of urban development in Guimarães, Europe's Green Capital 2026, as well as the [BiodiverCity article](#) on Limerick's strategy creation process.



Sinead McDonnel, Limerick's biodiversity officer
© Limerick City and County Council

Appoint a Biodiversity Officer - or create a unit dealing with this topic

One of the key components of the city's success is the establishment of the Landscape Laboratory in 2024, a unique centre for environmental research and education, focusing on three main areas of intervention: research and education, project management, communication and environmental training. The existence of the Landscape Laboratory makes the city's dedicated effort visible to all and highlights a truly European message to all cities: activating residents along green areas and issues is the role of municipalities in the shadow of the ecological crisis.

In Ireland, in collaboration with the Heritage Council and supported by the Department of Housing, Local Government, and Heritage, 30 Local Authority Biodiversity Officers started the work at the beginning of 2024 ([website](#)), and the goal is to have a Biodiversity Officer as well as a dedicated biodiversity action plan in all local authorities.

Biodiversity Officers are employed by local authorities and work at the city and county levels, collecting data on biodiversity, carrying out conservation projects, developing policies, providing advice and information and raising awareness.

Biodiversity officers work closely with other professionals within the local authority, as well as with the wider community in each city and county. Their role is diverse and defined by individual local authority preferences, but with a core focus on strategic planning and collaboration. Their responsibilities include:

- ✓ Creation of a Local Biodiversity Forum
- ✓ Writing a Local Biodiversity Plan
- ✓ Research, surveys and data collection
- ✓ Providing advice on biodiversity for local authority staff
- ✓ Community engagement and raising awareness
- ✓ Development of strategies, policies, and projects relating to wildlife, habitats and biodiversity
- ✓ Provision of biodiversity expertise to groups such as the Heritage Forum or the Climate Action Team

The breadth of these responsibilities highlights the pivotal role that biodiversity officers play in promoting awareness, knowledge and appreciation of local biodiversity through their work. Check out further [info](#) and a promotional [video](#) about the Local Authority Biodiversity Officer Programme!

Their work related to collaboration with different local players includes (examples based on the activities of Limerick's Biodiversity Officer, Sinead McDonnell, whose work is summed up within a [case study](#)):

- [Irish Catholic Bishops](#): 30 % of church grounds return to nature by 2030. 12 Limerick Parishes are forming a networking group to make progress.
- Applying for funding to produce the Limerick Biodiversity Action Plan and for different biodiversity projects.
- Contributing to the annual Tidy Towns Seminar focused on [wetlands](#) and wetland birds.

● Organisation of local events like the Bat & Moth Walk with [Albert Nolan](#), listening to the Dawn Chorus, Biodiversity Talks with biologist [Éanna Ní Lamhna](#), Guided Walk with [Geoff Hunt](#), online talks on Invasive Species with [Colette O'Flynn](#) for local authorities and [Tidy Town Groups](#), and many citizen science events.

- Collaboration with Limerick Libraries to build capacities, place new books, and promote events.
- Organisation of a training for managing hedgerows.
- Capacity building for local organisations.
- Management of the Limerick City Swift Nest Box Project.
- Organisation of engagement and sensitisation projects like [Sound Mapping](#), [Pyramid of Life](#), or [Meet a Tree](#).



© Berlin Urban Nature Pact

Join the Berlin Urban Nature Pact and be inspired by other international networks!

Urban green infrastructure, nature-based solutions and urban biodiversity are high on the EU as well as the global policy agenda. Cities aiming to get knowledge can learn from many inspirational networks, such as the Green City Accord initiative, Eurocities' related work, Tree Cities' activities, and the national Nature-based Solutions Hubs.

However, the most relevant network is most likely the Berlin Urban Nature Pact, an alliance of cities to implement global biodiversity goals locally. Signatory cities will implement targeted and visible actions, projects, and processes by 2030. The Pact, initiated by Berlin, seeks to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and the planet in cities worldwide by 2030. It builds on the 2020 [Edinburgh Declaration](#) and the 2022 [Montreal Pledge](#) and focuses on implementing the [Kunming-Montreal Global Biodiversity Framework](#) and renewed [Plan of Action on Subnational Governments, Cities and Other Local Authorities for Biodiversity \(2023-2030\)](#). The Pact set out the following seven target areas covering the following key topics of biodiversity action.

- 1 Education and nature experience
- 2 Species and habitats
- 3 Co-habitation
- 4 Green infrastructure and ecosystems
- 5 Blue infrastructure and water management
- 6 Soil health
- 7 Food and agriculture

Signatories will lead the path towards a nature-positive urban century and commit to a minimum of 15 out of 28 targets of the above target areas by 2030 (at least one target from each target area). Within one year, they must create an action-oriented action plan. Signatory cities have to follow the Implementation Principles behind the Pact (commitment, action and ambition; policy, governance, financing & funding frameworks; exchange and joint learning; co-creation; capacity building, environmental justice; reporting and monitoring), and they can benefit from exchange and learning (e.g. networking, monitor-

ing, communication, public relations and events) with peer cities. The Pact Coordination Office will facilitate the capacity building and city exchange.

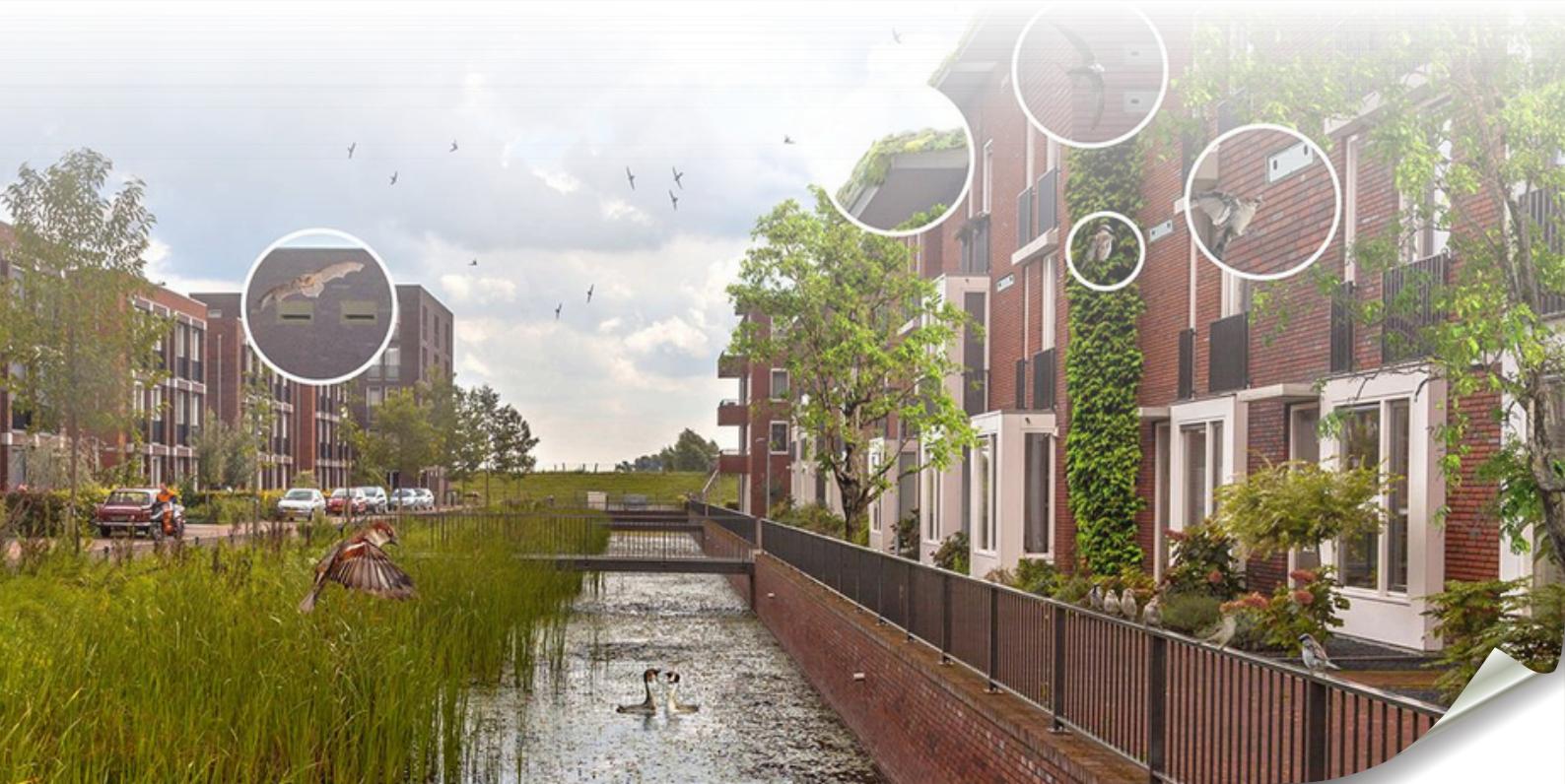
The pact was launched during the cities summit at the CBD COP-16 in Cali. First cities (Austin, Utrecht and Cali) signed the pact in Cali, while

many others raised their interest (incl. Vienna, Boulder, Bogotá, São Paulo, Buenos Aires, Kaohsiung).

Further information about the Pact: <https://citieswithnature.org/berlin-urban-nature-pact/>

According to a new legislation in Den Bosch, buildings must include fauna facilities for at least three species, if more than 500 m² of paving is created.

© [Checklist Groen Bouwen](#)



FUNDING URBAN BIODIVERSITY



Funding urban green infrastructure might be a challenge, yet the story is full of contradictions. On the one hand, according to the EU Biodiversity Strategy 2030, 1€ invested into habitat restoration generates 8–38€ profit in Europe. Despite pioneering work to highlight this, such as the EU integrated system of ecosystem accounts, which has estimated that ten ecosystem services generated EUR 234 billion in benefits annually, ecosystem services remain difficult to monetise and are not adequately reflected in market price signals (*Roadmap towards Nature Credits, European Commission*). This contributes to over-exploitation and chronic underinvestment in nature restoration and protection. As a result, nature restoration and protection mainly rely on public funding.

On the other hand, biodiversity-inclusive urban green space management is often cheaper than traditional methods. As described in the case study of Veszprém, climate-adaptive urban grassland management produces ca. 20% savings for the municipality.

Although investments in green infrastructure or NbS are increasing according to the Greening Cities Urban Agenda Partnership, private finance plays a crucial role to reach globally set targets as the public sector cannot, economically speaking, bear alone this achievement. On top of that, if we consider the limited city spending autonomy, we understand why investment in the private sector is essential to green our cities. Public-Private Partnership can be a good way to help finance green infrastructure in cities; however, it seems challenging due to the undefined value of the assets and the difficulty in calculating expected profits. Therefore, the Partnership aims to raise awareness on alternative ways of financing green infrastructure by giving examples of good and bad practices of urban authorities regarding innovative funding.

The Greening Cities Partnership of the Urban Agenda released a position paper urging bold reforms in EU and national funding systems to unlock large-scale investment in Urban Green Infrastructure. To address the challenges, the paper outlines a package of nine strategic recommendations. These include “*mandating ERDF*

allocations for urban green infrastructure with binding targets of 10–15%, integrating urban-specific green infrastructure strategies into operational programmes, and embedding green infrastructure funding priorities across key EU programmes like LIFE, Horizon Europe, and the European Urban Initiative. It also calls for long-term maintenance costs to be covered as flat-rate overheads, simplification of funding procedures, and the creation of EU-level pre-financing and risk-sharing mechanisms. Further recommendations focus on enabling blended financing, supporting national green infrastructure funding frameworks, building municipal capacity, and investing in smart tools and decision-support systems”.

This is in line with the global process. The Kunming-Montreal Global Biodiversity Framework calls for substantially increasing financial flows from all sources, mobilising at least USD 200 billion per year by 2030, including through innovative finance. Nature credits can be a key tool to reward nature-positive action through private investment to the benefit of nature and businesses. In this model, certification assures that specific high-quality, nature-positive actions are implemented in line with pre-defined criteria or principles. This two-step model – certification followed by crediting – could open the door to innovative financing mechanisms. Certificates help structure and catalyse nature-positive investment by providing the basis for contractual payments or guarantees, while credits could monetise the demonstrated impact, potentially offering dividends to suppliers and early investors.

The EU Regulation on Carbon Removals and Carbon Farming (CRCF) establishes a voluntary certification system for carbon removals and ecosystem-based emission reductions achieved in the EU, built on robust monitoring, reporting and verification. It introduces the two-step process of certificates of compliance and certified units, which simplifies access to private finance and anchors the system on strict criteria for quantification, additionality, long-term storage and sustainability.



How to make narrow pedestrian streets more green (Cieza, Spain)?

© Ferenc Albert Szigeti

However, these great and ambitious goals and innovative financing mechanisms primarily target territories with high biodiversity; therefore, urban

authorities with degraded ecosystems most likely are not the main target groups of these innovations.

The case of Cieza

The BiodiverCity partner Cieza is a good example of how to target local environmental and climate goals within direct EU funding schemes and gain funds for innovative ideas meeting global and EU challenges. Cieza is a small Spanish city in the region of Murcia. It suffers from more and more serious heatwaves and drought periods; therefore, the municipality of Cieza has understood that urban trees provide inevitable services and cost-efficient solutions for urban dwellers, and it has built up its comprehensive climate action in the last 10 years. Based on its strategic thinking, it became a national frontrunner, and Cieza has managed to gain different funds from the LIFE Programme for its goals.

This is also related to the fact that Cieza is an active player in international networks. For example, it has signed the Green City Accord, a movement of over 100 European mayors committed to making their cities greener, cleaner and healthier by 2030. By signing the Accord, these cities commit to addressing five areas of environmental management: water, air, waste, noise and nature. Although it does not mean direct funding, it gives structure to local environmental work, an opportunity to contribute to shaping the national and EU environmental policy, and helps increase the transparency, accountability, and credibility within the local community, which can be important when applying for EU projects and external funding.

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