



D1.3.1. Training materials

Version 1

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Deliverable ID

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A1.3 Delivering Interactive Capacity Training Sessions

D 1.3.1 Training materials

1. Goals and learning objectives

The training session “Building impact through data: from baseline collection to planning and pilot design”, delivered in Barcelona on 17 February 2026 within the **UrbanGreenLeap** EU-funded project, focused on strengthening the capacity of partner cities to use data effectively for the development of Urban Nature Plans (hereinafter UNPs) and the planning and design of Nature-based Solutions (hereinafter NbS) demonstrations/ investments.

The session aimed to demonstrate how baseline data collection and spatial analysis can support evidence-based decision-making, allowing cities to better diagnose environmental challenges, prioritize interventions, and measure the impact of urban nature actions.

- **Goals:** by the end of the training, the partners will be able to understand the key concepts described in the Base line study, be prepared to roll-up of Urban Nature Plans and integration of key indicators
 - **General learning objectives**
 - To understand and apply some of the key concepts (i.e. described in baseline study)
 - To build an urban biodiversity data base and understand its benefits
 - To design an inclusive and transformative participatory approach
 - To design, plan and implement nature-based solutions (i.e. urban forests)
-



- To define realistic and meaningful data/indicators for urban green planning
- To understand why, where, when and how to act in terms of inclusive urban green planning from a multidimensional perspective (i.e. which indicators to use to monitor the effectiveness of a plan; which species to plant to adapt to global change; which ecosystem services are provided by urban forests and how to enhance them; how to boost public trust and engage citizens; how to protect and empower urban nature etc.)
- To boost cities engagement and continuous learning

2. Structure and criteria

The training session consisted of four main blocks of approximately one hour each, focussed on the following key concepts for urban green planning:

- (1) **Urban biodiversity**, led by CREAM.
- (2) **Participatory process**, led by IPoP.
- (3) **Urban Forests as Strategic Nature-Based Solutions**, led by UNIZG FFWT.
- (4) **Building impact through data: from baseline collection to planning and pilot design**, led by Ambiente Italia srl.

In order to make the training dynamic and engaging, the trainees were encouraged to use, whenever possible, clear references/links and include innovative materials and tools in their presentations (videos, other existing training material or management tools, podcasts, case studies etc). The complex concepts were agreed to be introduced, when necessary, but they were explained using friendly approaches. Each trainee had the liberty of structuring the training objectives and the structure of the presentation according to their own expertise and training experiences.

All training sessions were built with a clear science-policy-practice focus and tailored to cities needs and pilots.



3. Description of the training sessions (summaries and presentations)

Session 1: Urban biodiversity (Authors: Corina Basnou, Shichun Ma, Sandra Calduch and Joan Pino, CREA, Spain)

Objectives

- To understand the definition and concept of urban biodiversity
- To build realistic and meaningful tools for urban biodiversity monitoring (i.e. biodiversity atlas) and understand their benefits
- To integrate the vision on urban biodiversity into cross-sectorial approach in cities

Biodiversity means the variety within and between organisms of an ecological system. Biodiversity encompasses genetic diversity, species diversity and ecosystem diversity, including functional diversity, which reflects differences in the biological traits of species. Some projects mention a 4th level, the cultural biodiversity and therefore this session briefly mentioned related concepts, such as the extinction of “biodiversity and cultural literacy”). Biodiversity is a key element, the basis of ecosystem processes, functions and services.

Urban biodiversity refers to the variety and variability of living organisms found in urban environments, including their habitats, and the ecological interactions among them within cities. Urban biodiversity is a subcomponent of broader biodiversity, focused specifically on the human-dominated landscapes of cities and metropolitan regions. Local vs broad scale, urban vs peri-urban - landscape factors (such as landscape context, landscape configuration, dynamics and history) are also important determinants of the urban biodiversity. Fragmentation (urban areas disconnected to rural areas - i.e. the concept of agro-sylvo-pastoral landscape) drives biodiversity loss. Therefore, a major recommendation provided by research findings emphasizes the need to preserve natural remnants from urbanization impacts.

The presentation gave insight on key aspects of measuring biodiversity, beyond species richness. Biodiversity encapsulates many different aspects



of biological organization and information. For example, phylogenetic diversity is important, since there is evidence that greater phylogenetic diversity leads to a higher ecosystem stability. Scientists study phylogeny to understand the evolutionary history of species and their relationships. Taxonomy for example, which is the science of classifying organisms, relies on phylogeny to reflect the natural relationships among living things.

The importance of species abundance or traits when sampling flora or fauna are highlighted. Knowledge of species traits (data available in open database, such as Biodiversity Atlas of Barcelona) is closely related to ecosystem functions and services and it is fundamental for urban green planning (i.e. canopy size, plant high or leaf morphology).

A brief introduction on challenges/drivers of biodiversity loss was followed by some key aspects from recent research on challenges related to pollution and health safety thresholds, especially in the case of heavy metals pollutants and their bioaccumulation and soil persistence. Various aspects of monitoring biodiversity and the use of plants as bioindicators was highlighted. Key role of plants/urban gardens as bioindicators of air quality (e.g. heavy metals monitoring on leaves chard) was mentioned. The first part of the presentation recalled the need to include all these aspects for biodiversity planning strategies in cities (traits, flora & fauna diversity, pollution & human health, ...).

Within cities we find a very particular nature: “nature in a small pot” (J. Pino). Studies showed that urbanization is able to globally decrease plant diversity by fostering common species with “urban-adapted” trait states, by limiting rare species with traits less suitable for urban environments, and by decreasing phylogenetic diversity. Research also provided evidence that seminatural areas within cities, e.g. protected areas, parks, and even gardens, can protect species with traits less suitable for the typical urban built-up environment. Therefore, a mix of semi-natural habitats and typical urban-industrial habitats within a city (if the latter are allowed for spontaneous vegetation) should permit both semi-natural and typical urban floristic elements and thus enable functional and phylogenetic diversification.

But how can we take advantage of this particular urban nature, while trying to restore and maintain local biodiversity and its ecological functions as most as possible? To respond to this question, the training also showed examples of enhancing urban biodiversity hotspots, such as urban gardens or tree pits (i.e. where spontaneous plants benefit key fauna like pollinators).



Cities can harbour high biodiversity, including endangered species that sometimes live only in these urban habitats.

In the same line, the last part of the training session focussed on how public geodata based on species inventories in cities can help mainstreaming urban green planning and management.

When planning biodiversity strategies, first we can ask ourselves which species live in our garden or city and then try to organize databases with all this information. In that way, we can understand the importance of evidence-based for planning, such as the Biodiversity Atlas of Barcelona (implemented in 2019). Along with the specific field sampling designed for urban flora and fauna, citizen science projects fed the data available in the open Biodiversity Atlas of Barcelona (such as <https://ubms.creaf.cat/en/> for butterflies).

In the end, Session 1 presented *practical examples* of the benefits of accessible, high quality, georeferenced data on urban biodiversity, with focus on *Trees Smellscape in Barcelona*. This is part of an ongoing PhD of student Shichun Ma, at UAB/CREAF Scientific studies. The student talked about the importance of smell in urban planning. Smell is associated with emotions, memory & stress. Shichun´s recent research on urban trees traits led to the development on the first scented trees interactive species explorer in Barcelona, free open use, based on data from the Biodiversity Atlas of Barcelona. Results revealed some gaps in inclusive urban green planning. There is a lack of scented trees near schools and hospitals.

As an ancillary information, the training on Urban biodiversity also presents the newest concept related to “**3-30-300 rule**”, as an example of storytelling and successful narrative to mainstreaming urban forests (and urban green in general) and boost impact in cities (Author: Sandra Calduch, PhD student, CREAM).

Methods

The main material for this session was the **Biodiversity Atlas of Barcelona**, also part of Best Practices Catalogue. We used a PowerPoint presentation and a demonstration video (Atlas of Biodiversity and Smellscape)

<https://ajuntament.barcelona.cat/atlesbiodiversitat/en/>

**This session complemented the previous lesson and co-design sessions on “Nature-based solutions” held by CREAM in Milano (2025).*



Main takeaway

- **Biodiversity needs a cross-sectorial approach in cities.** Urban policies should move towards cross-sectional approaches that coordinate planning for biodiversity and green spaces with sectors such as health, education, urban planning and design.

Session 2. Participatory process (Maja Simoneti and Urška Didovič, IPoP, Slovenia)

The training session was structured across the following main points:

- introducing new typology and imaginary of public green space and greened areas/buildings
- new collaborators – specialists for: biodiversity, urban water management, urban heat mitigation, public health and well-being, social equality and cohesion
- potentials, needs and interests for participation

Transversally, the key drivers for successful participation and new participatory practices have been highlighted.

Special emphasis was made upon: the importance of empowering early and assuring meaningful collaboration; raising awareness about biodiversity loss and NBS; meeting social needs of local community and ensuring adaptation to climate change; long-term planning and management strategies and collaborative practice of maintenance.

The training described the types and methods of participation, raising awareness upon the strengths and weaknesses of each method. Special emphasis was made upon knowing the target audience (i.e. comprising diverse mixture of • groups • interests • roles & positions • languages! • powers • responsibilities) and tailoring the methodology according to participants and interests.

Realistic expectations, equality of participants, publicity of professional activities, respect/trust/consideration will assure a robust participatory approach.



Success factors and barriers in participatory process were further detailed, with a first approach tailored on cities pilots to design the further steps for successful participatory approaches.

Transversally, the training reforced concepts presented in the previous Baseline study (D1.1.1.) and highlighted the advantages of public participation in NBS development phases, which should be critically taken into consideration:

- solutions better tailored to the needs of public by acknowledging diverse needs, perspectives, views and opinions
- improved information base and quality of solutions
- better public understanding and acceptance of new solutions and
- raising sense of identification with new solutions and willingness to involve in care taking and maintenance.

Moreover, if participation process is properly planned and executed, it can strengthen the sense of belonging, enhance social cohesion, equity and inclusion, deepen trust in the local government and encourage stewardship. It is important, however, to critically consider the potential, plan the participation process carefully, work with the public to develop solutions that are acceptable for both sides throughout the processes.

The participation can also provide expected social outcomes beyond inclusivity, such as: knowledge development, awareness raising, social learning, employment, decision-making reflexivity, changes in attitudes and/or social norms and sense of place.

Methods

Multimeter and open discussion with the cities around a key question: *Have you ever involved people in any way?*

Main takeaway

A successful participatory approach to **implement NBS should meet social needs of local community and ensure adaptation to climate change.**



Session 3. Urban Forests as Strategic Nature-Based Solutions (Vinko Paulić and Iva Šikić-Vargašević, UNIZG FFWT, Croatia)

Urban forests serve as essential components of green infrastructure in cities. They include forests in peri-urban zones, city parks and urban forests, smaller parks and gardens, street trees and all other areas with woody vegetation in cities. They function as long-term assets that improve environmental quality, support public health, and help cities adapt to climate change. As urbanization accelerates across Europe, where more than three-quarters of the population already lives in urban areas, the role of urban forests in supporting sustainable development becomes even more important.

Urban forests face a number of environmental pressures that reduce their resilience. Increasing temperatures and the rising frequency of heatwaves create challenging growing conditions for many tree species. Heavy rainfall events and sealed surfaces increase runoff and soil erosion, while pollution further stresses trees and reduces their capacity to provide ecosystem services. Limited rooting space in compacted urban soils also restricts tree growth, leading to shorter life spans and reduced functional benefits. Emergence of new pests and diseases coupling with loss of biodiversity in urban areas further emphasizes the need for proactive management and long-term planning of urban forest resources.

Despite these pressures, urban forests serve as highly effective nature-based solutions which tackle many of these environmental issues. They reduce urban heat island effects by providing shade and cooling through evapotranspiration, which results in significant reduction of temperatures in densely built areas. Trees also improve stormwater management by intercepting rainfall, improving soil infiltration, and reducing runoff volumes. In addition, increasing tree canopy cover contributes to better air quality by reducing particulate matter and pollutants concentrations. These benefits as a result support public health, reduce infrastructure costs, and strengthen overall climate resilience.

To support informed decision-making, city professionals rely on several key indicators of urban forest performance. These, among others, include the total number of urban trees, overall tree canopy cover and the accessibility of green spaces for residents. Recommended standards include reaching 30 percent canopy cover, providing at least nine square meters of green space per person, and ensuring that residents have access to green areas within a short walking distance. Tree inventories and geographic information



systems play an important role in monitoring resources, identifying priority areas, and guiding investment decisions.

Looking ahead, cities must incorporate climate-adaptive planning with appropriate species selection into their urban forest strategies. Selecting resilient species that tolerate drought, heat, or periodic waterlogging will improve long-term performance and reduce maintenance risks. Enhancing biodiversity through diverse species mixtures, preserving habitat trees, and integrating conservation measures strengthens ecological stability and supports urban wildlife.

Urban forests are strategic assets that contribute to healthier, more resilient, and more livable cities. By embedding urban forests into planning policies and prioritizing long-term management, cities can ensure that they continue to deliver essential ecosystem services for future generations.

Methods

Oral presentation and co-creation workshop.

The objectives of the workshop

Provide participants with a solid understanding of key concepts related to climate change, climate risks, and the principles of nature-based solutions (NbS), ensuring a theoretical foundation for practical applications.

- Foster innovative and strategic thinking, encouraging participants to go beyond conventional approaches and consider multidisciplinary and systemic solutions in urban planning and project design.
 - Enhance participants' competence in the NbS project design process, including problem identification, risk assessment, conceptual development, and implementation planning in real urban and municipal contexts.
 - Develop participants' ability to identify, analyze, and prioritize climate risks, taking into account hazard exposure, vulnerability, and potential impacts on urban infrastructure, ecosystems, and communities.
 - Guide participants in selecting and defining measurable Key Performance Indicators (KPI) to evaluate the effectiveness, resilience, and sustainability of NbS projects, ensuring evidence-based assessment and justification of project outcomes.
-



Climate change is increasingly affecting environmental conditions across Europe, leading to higher temperatures, more frequent heatwaves, droughts, and intense rainfall events. These changes are expected to become more pronounced in the coming decades, creating significant challenges for societies, ecosystems, and economies. Cities and urbanized areas are particularly vulnerable to these changes. Due to high population density, extensive infrastructure, and large areas of heat-absorbing surfaces such as concrete and asphalt, urban environments often experience stronger climate impacts, including the urban heat island effect and increased flood risk.

Climate risks refer to the potential negative impacts resulting from climate-related hazards such as heatwaves, floods, droughts, and storms, combined with the exposure and vulnerability of people, infrastructure, and ecosystems.

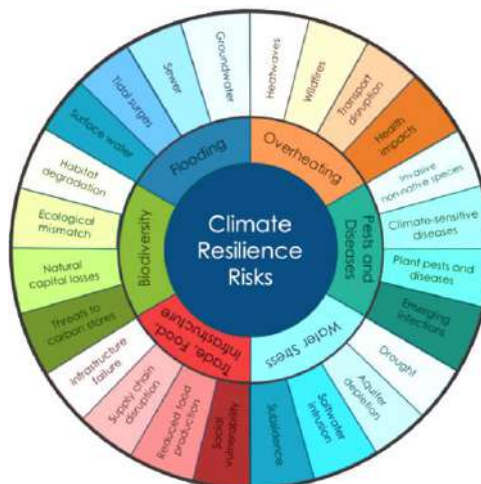


Figure 1. Climate Risks diagram (*Climate Action Strategy*)

Key Performance Indicators (KPIs) in the context of Nature-Based Solutions (NbS) are **specific, measurable metrics** used to assess how effectively an NbS intervention delivers its intended environmental, social, and economic benefits.

In urban NbS projects, KPIs help track outcomes such as: **Climate mitigation** (e.g., carbon sequestration, reduction of urban heat), **Biodiversity improvements** (e.g., species richness, habitat area), **Water management** (e.g., stormwater retention, water quality), **Social impacts** (e.g., community access, recreational use), **Economic benefits** (e.g., avoided damages, cost-effectiveness)



A good KPI is **relevant to project goals, quantifiable over time, and usable for monitoring, reporting, and adaptive management**

Table 1. KPI

Category	KPI	Unit	Measurement Method / Notes
Climate & Environment	Carbon sequestration	tCO ₂ e/year	Estimated from tree biomass and soil carbon using IPCC factors*
	Urban heat reduction	°C	Temperature sensors, thermal imaging
	Air quality improvement	µg/m ³ (PM2.5, NOx)	Air quality monitoring stations
Biodiversity & Ecosystem Services	Number of woody species	Count	Field survey of trees and shrubs
	Species richness	Count of birds, mammals, insects, fungi	Field survey, ecological monitoring
	Habitat connectivity index	Index value	GIS analysis, ecological connectivity models
Water & Hydrology	Stormwater retention capacity	m ³	Hydrological modeling, site measurements
	Reduction of runoff	% decrease	Flow monitoring, hydrological modeling
	Water quality improvement	Concentration decrease (mg/L)	Water sampling and lab analysis
Social & Urban	Access to green space	% of population	GIS mapping, urban planning data
	Community participation	Number / %	Surveys, records of engagement activities
	User satisfaction / recreational use	Survey score / number of visits	Questionnaires, observation, mobile tracking
Economic	Cost-benefit ratio	Ratio	Economic analysis comparing investment and monetized benefits
	Avoided damage / disaster costs	€	Risk modeling, historic damage data
	Green jobs created	Number	Employment records, project reports



***IPCC factors** refer to the **emission and sequestration coefficients published by the Intergovernmental Panel on Climate Change (IPCC)**, which are used to estimate greenhouse gas (GHG) emissions or removals from various sources, including forests, soils, and land-use activities.

Description of the workshop

In order to address all key project themes, including biodiversity enhancement, heat mitigation, and stormwater management, participants were assigned practical tasks and worked in teams.

Participants were divided into two groups, and each group was assigned a real location for which they were asked to identify potential climate risks. Based on these risks, the participants were tasked with designing a project based on **nature-based solutions (NBS)** and defining **key performance indicators (KPIs)** that could be used to demonstrate and evaluate the impacts of their proposed projects.

The first group worked on a scenario in which they had to redesign and improve the existing green infrastructure. The second group focused on transforming grey infrastructure into green infrastructure, proposing solutions that would enhance environmental performance and climate resilience.

Group: LEFT

Pilot action them: ENHANCING BIODIVERSITY

Task: CREATE AN IDEA TO ACHIEVE THE ACTION THEME

Location Description: Between two roads and sidewalks, there is a relatively small green area.

a plane tree alley with a total surface of 240 square meters. The trees are relatively old and play an important role in providing numerous benefits to residents of the neighborhood. The space is almost unnoticeable, with only ten plane trees and no other vegetation. The soil is compacted and degraded.



Figure 2. Location for the group LEFT

Group: RIGHT

Pilot action them: HEATH MITIGATION

Task: CREATE AN IDEA TO ACHIEVE THE ACTION THEME

Location Description: The subject site is located in a built-up area of the city dominated by grey infrastructure. The 130 m² surface is fully paved and is not equipped with a stormwater drainage system. Due to the impermeable surface, rainwater accumulates on site, while during the summer months the area overheats, negatively affecting the microclimatic conditions and overall quality of use.



Figure 3. Location for the group RIGHT



To ensure better understanding and facilitate the work process, participants were provided with worksheets containing tasks that guided them through the process:

I.	Short description of the problem
II.	Climate risks (minimum 3)
1.	
2.	
3.	
4.	
5.	
III.	Describe what you would propose for the redesign of the space, with the aim of mitigating the identified risks (In a few sentences, explain what you would do at this location).

IV.	Cost of a project - write it on the board (Circle one of the options provided)	low	medium	high
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V. Benefits (mark with a “+” if your project achieves any of these benefits)

Intercepting rainfall	Surface water management	Rainwater storage	Air quality improvement	Enhancing biodiversity	Urban heat island	Carbon reduction

Economic savings	Heating/cooling load reduction	Energy consumption reduction	Increased property value



Indoor thermal comfort	Streetscape improvement	Health and wellbeing	Noise reduction	Amenity space

VI. Based on the benefits and the table in the attachment, propose five KPIs and explain how you would conduct the measurements.

	KPI	Measurement Method / Notes
1.		
2.		
3.		
4.		
5.		

Results

Each group selected a representative to present their work. During a five-minute presentation, they thoroughly outlined the key problems and climate risks identified in their assigned location, described their project concept and proposed implementation strategies, and concluded by defining the relevant Key Performance Indicators to measure the effectiveness and impact of their nature-based solutions.

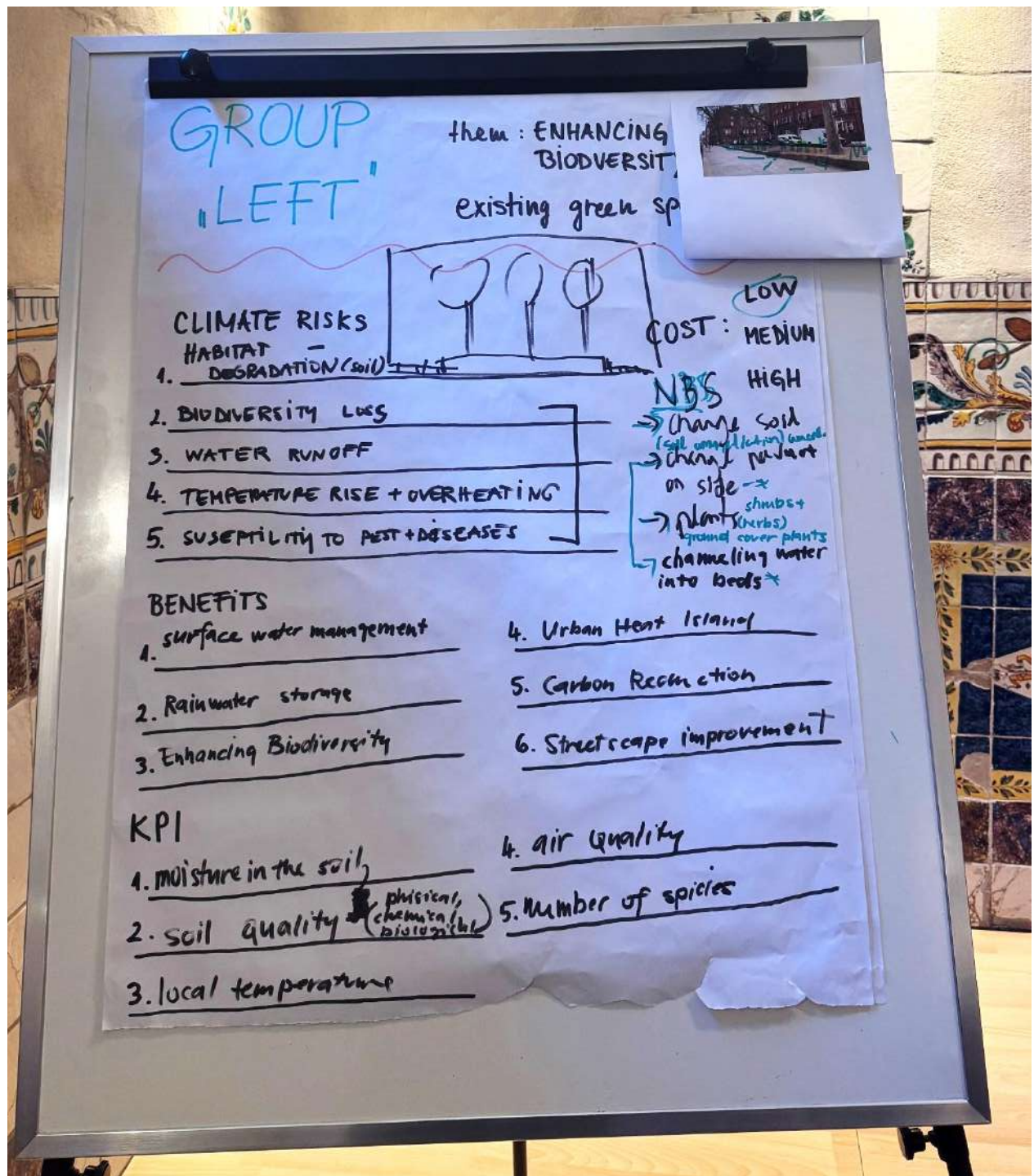


Figure 4. Results group LEFT

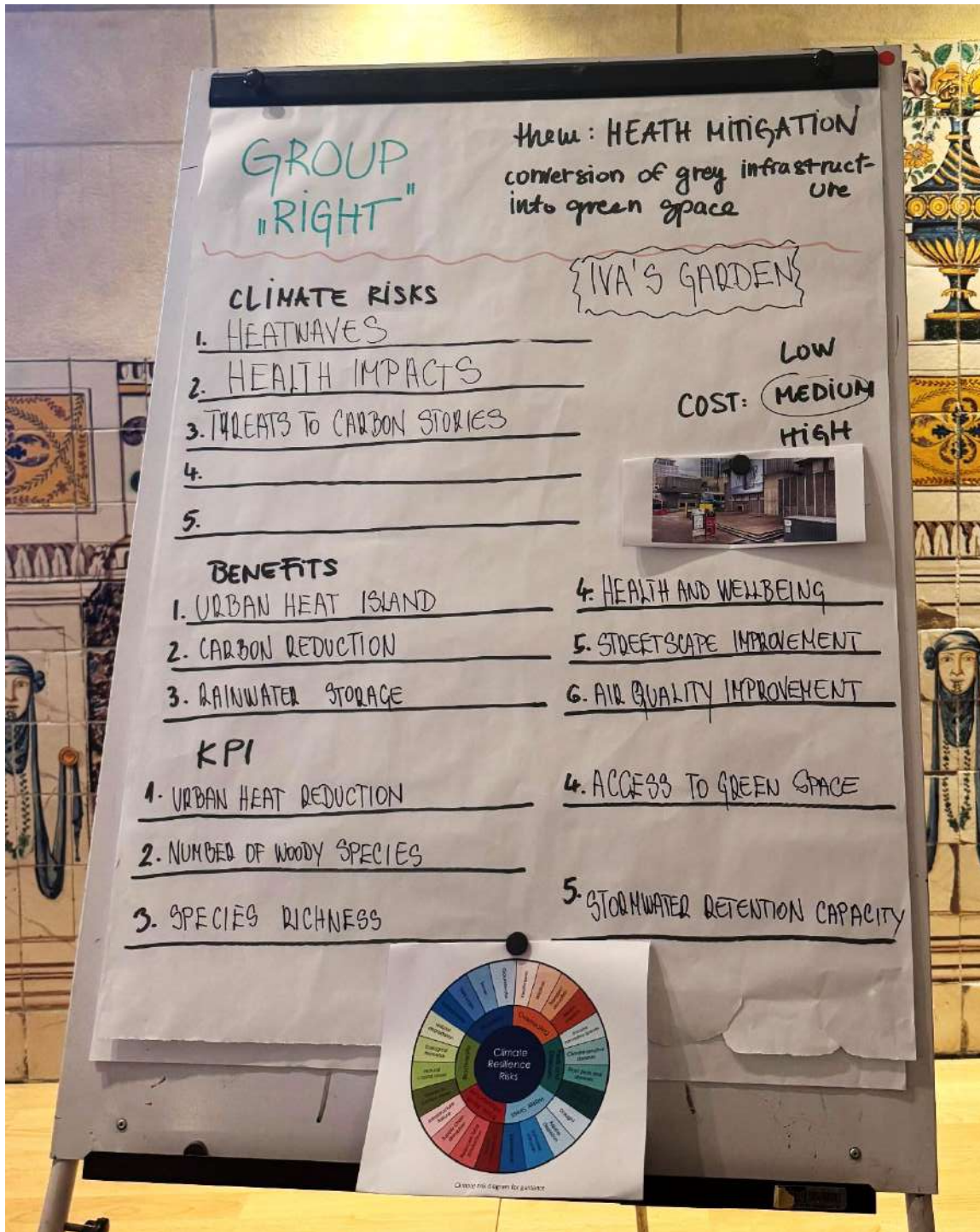


Figure 5. Results group RIGHT



Session 4. Building impact through data: from baseline collection to planning and pilot design (Iliriana Sejdullahu, Ambiente Italia srl.)

Objectives

The training addressed three main objectives:

- **Understanding the importance of baseline data** for evidence-based urban nature planning aligned with EU policy frameworks.
- **Learning what types of data cities need** and how to use them to design Urban Nature Plans and pilot actions.
- **Demonstrating a practical example of NbS spatial mapping**, showing how GIS-based data can support planning and decision-making.

A key premise of the training was that cities often operate under constraints such as limited GIS expertise, uneven data availability, and limited monitoring resources. Therefore, the proposed methodology (for more see D. 2.1.1. Methodology for the collection of beta data) emphasized flexible and accessible data approaches that can work across different administrative and technical contexts.

Data-driven approach to Urban Nature Planning

The training highlighted that data is not only used for reporting but forms the backbone of the entire planning cycle, linking:

Baseline data → Analysis → Planning → Pilot design → Impact → Monitoring.

A robust baseline for urban nature planning combines four complementary sources:

- Remote sensing and GIS datasets
 - Field surveys to assess urban ecosystems
 - Citizen science contributions supporting biodiversity observations
 - Administrative and municipal operational data such as land-use plans.
-



Application and practical example

The training illustrated how this approach supports **Urban Nature Plan** development, particularly through baseline analysis and the definition of **indicators and targets** such as green space coverage, tree canopy, biodiversity indicators and accessibility to green areas.

A practical case study from the Metropolitan City of Milan demonstrated how GIS-based mapping can identify existing green infrastructure, classify publicly accessible green areas and integrate multiple spatial datasets. The methodology supports decision-making by identifying priority areas for intervention and potential locations for new Nature-based Solutions.

The example also introduced a visual mapping platform that allows cities to analyse green space accessibility, assess ecological connectivity and communicate urban nature initiatives with citizens and stakeholders.

Key messages and importance for cities

- **Reliable baseline data is essential** for effective urban nature planning.
- **Spatial analysis helps cities prioritize interventions and justify investments.**
- **Integrating multiple data sources improves the understanding of urban ecosystems.**
- **Mapping and visualization tools support planning, monitoring and communication.**

By adopting a structured data-driven approach, cities can plan and design more targeted NbS pilots, align local actions with European policy objectives, and better demonstrate the environmental and social impact of urban nature interventions.



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WP1. Transformation

A common understanding to build synergies
and motivate new ways of thinking

Corina Basnou, Iliriana Sejdullahu, Maja Simoneti, Urška Didovič,
Tina Petek, Vinko Paulić

Milano, 10.09.2025



“Cities  have the
capability of providing 
something for  everybody,
only because, and only when,
they are created by
everybody.” 

–Jane Jacobs

Project
for Public
Spaces

WP1 A1.1. Establishing the State-of-the- art

Concepts

- **Baseline study**
- **Good practice catalogue**

Workshop 1

- Aligning concepts around how different vegetation typologies perform under different scenarios

Workshop 2

- **Partner-level baseline situation papers**
- Get the data

Let's start with the very beginning...



Small and medium cities – rural context and traditional landscapes



Rich cultural landscapes, memories and related knowledge



Urban/Metropolitan context



Many “urban natures”



Many related activities



Scale and context

Landscape gradient (mosaic) vs gradient loss





EU Biodiversity Strategy for 2030

Bringing nature back into our lives

“Improving knowledge, education and skills”



Interreg



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Co-funded by
the European Union

Bring nature back to cities



**URBAN
NATURE
PLANS +**



EU Biodiversity Strategy for 2030

Bringing nature back into our lives



Bring nature back to cities

**Preserve and be aware of
what you already have!**



**URBAN
NATURE
PLANS +**

Let's start with the very beginning...



Green Infrastructure

GI is defined as a “strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of **ecosystem services**” (European Commission 2013)

Green infrastructure planning is a holistic approach

- Combines ecological and social perspectives is broadly acknowledged
- More effective and handles more complexity than traditional planning for nature conservation or open space
- GI planning appears to be especially suited for urban areas

Hansen, R., & Pauleit, S. (2014). From multifunctionality to multiple ecosystem services? A conceptual framework for multifunctionality in green infrastructure planning for urban areas. *Ambio*, 43(4), 516-529.

Green infrastructure is multifunctional

>> Operational frameworks for GI planning is based on data on

- Biodiversity
- Ecosystem services provision and demand – societal needs (>> human beneficiaries)
- Functions (ecological connectivity, soil formation, evapotranspiration, wetlands processes etc)

“Biodiversity-friendly city”

“Biodiversity and Functions Myopia”



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How can we take advantage of the urban nature, while trying to restore and maintain local biodiversity and its ecological functions as most as possible?

Green infrastructure planning is place-based



Urban Forestry & Urban Greening

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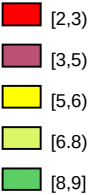


Advancing the green infrastructure approach in the Province of Barcelona: integrating biodiversity, ecosystem functions and services into landscape planning

Corina Basnou ^a  , Francesc Baró ^{b c}, Johannes Langemeyer ^{b c},
Carles Castell ^f, Carles Dalmases ^d, Joan Pino ^{a e}

Main contributions to the research on ES and functional ecology

Group	Indicators
Biodiversity	Singular biodiversity
	Functional biodiversity
Ecosystem Functions	Pollinators
	C stocks in shrublands and forests
	LAI/Leaf biomass
	Evapotranspiration
	Ecological connectivity
Regulating ES	Climate (Biomass increase)
	Runoff
	Air filtering
	Erosion control
Provisioning ES	Food provision
	Forest biomass provision
Cultural ES	Leisure opportunities





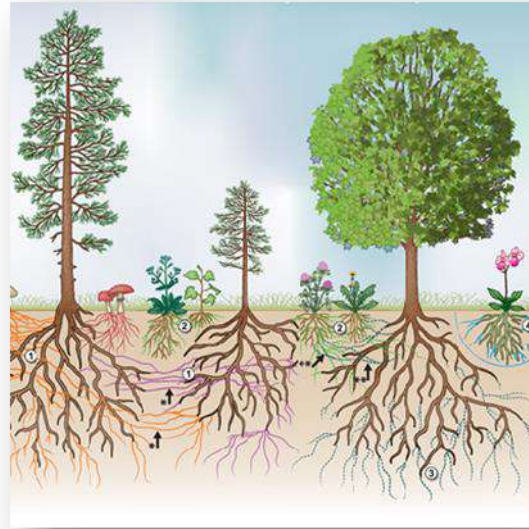
Ecological connectivity

Green infrastructure planning is also about plants ecology and biogeography

- Plant distributions and their geographical relationships with the environment (i.e. climate suitability, traits – drought tolerant, toxic, dispersal mechanisms etc)
- Bridging with Research (scientific papers, reports, keynotes, PhDs, expert knowledge)

Green Infrastructure components

A summary of vegetation typologies



Trees

Ecology and functions growing conditions

Plant distributions and their geographical relationships with the environment (i.e. climate suitability, traits – drought tolerant, toxic, dispersal mechanisms etc)

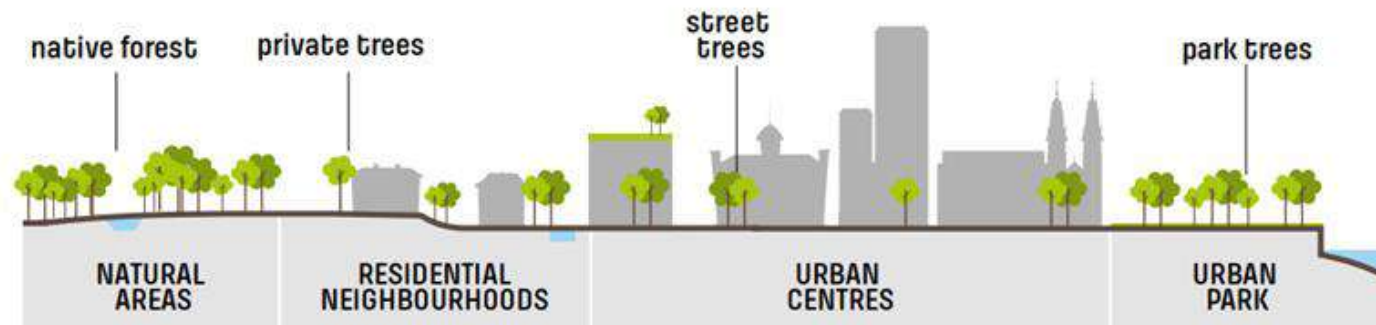
Focus on growing, not planting trees

- One large tree with a robust crown has more impact on human health and well-being than 10 young trees
- The older a tree is, the better it absorbs carbon (70% of all the C stored in trees is accumulated in the last half of their lives)
- Older trees which often provide specialist habitats for many unique types of insects and fungus species
- Better knowledge on species selection, tree beds, moisture, soil health and microorganisms ...

Urban forestry is about seeing people
and trees in a city as one unit

Cecil Konijnendijk

COMPONENTS OF THE URBAN FOREST



Urban forests



Climatic refugia

Evapotranspiration (moisture)

Air quality

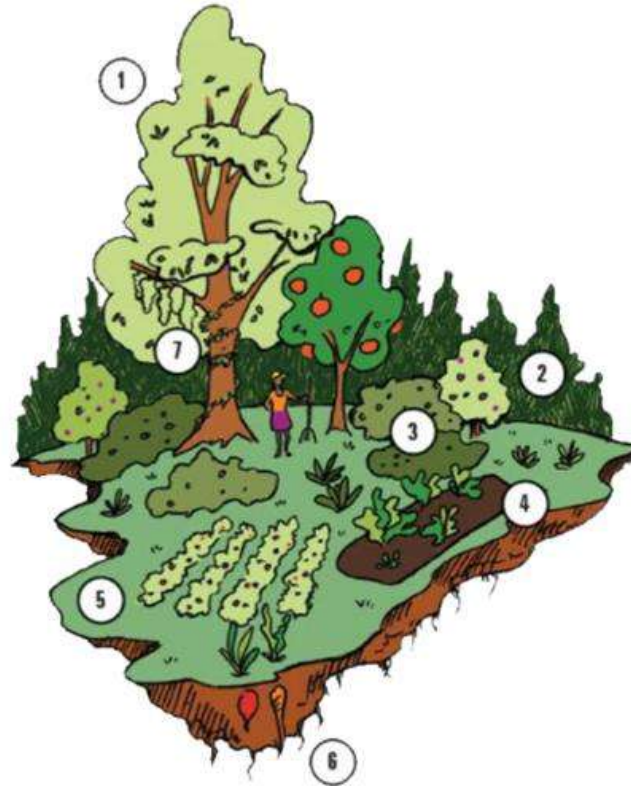
Restoring capacity

Education

Food forests, hedges –
food, tiny forests, pocket
parks, botanical gardens....

Food forests – edible landscapes

1.  Canopy Layer
2.  Understory Layer
3.  Shrub Layer
4.  Herbaceous Layer
5.  Groundcover Layer
6.  Root Layer
7.  Vine Layer
8.  Fungal Layer



Urban gardens (municipal - elderly, community, therapeutic, school...)



Biodiversity

Food provision (0 km food)

Climatic refugia

Air quality

Social cohesion

Well-being

Education

Urban meadows ... instagrammable landscapes

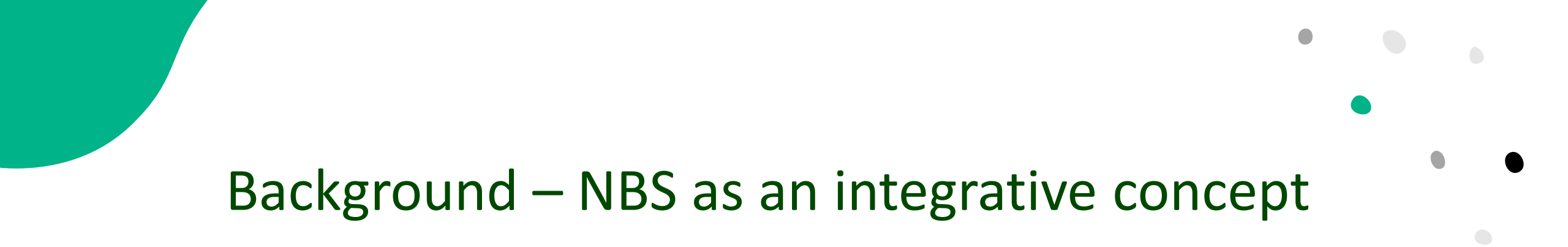


Nature-based solutions





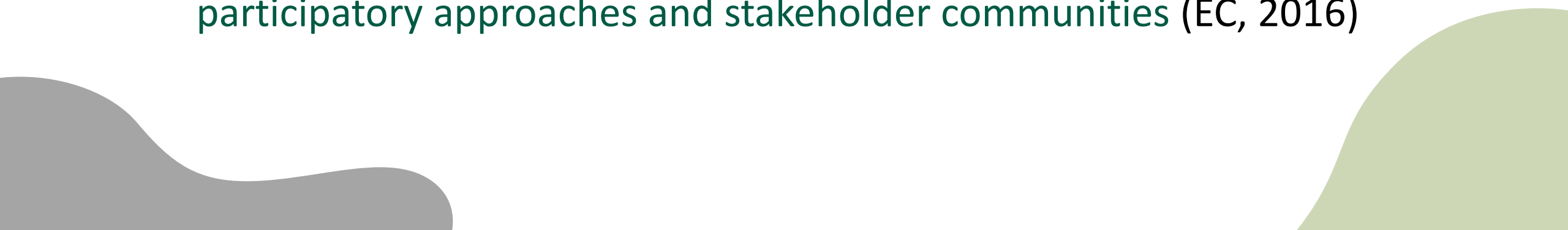
ONE RING TO RULE
THEM ALL



Background – NBS as an integrative concept

NBS are “actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature” (IUCN, 2023)

The European Commission recommended to increase the use of biodiversity and NBS and bring nature back into cities, to foster interdisciplinarity, participatory approaches and stakeholder communities (EC, 2016)



Nature-based solutions <> multifunctional green

Integrative

Ecosystem services

Biodiversity

*Participatory approach to their
planning and implementation*

Education and training



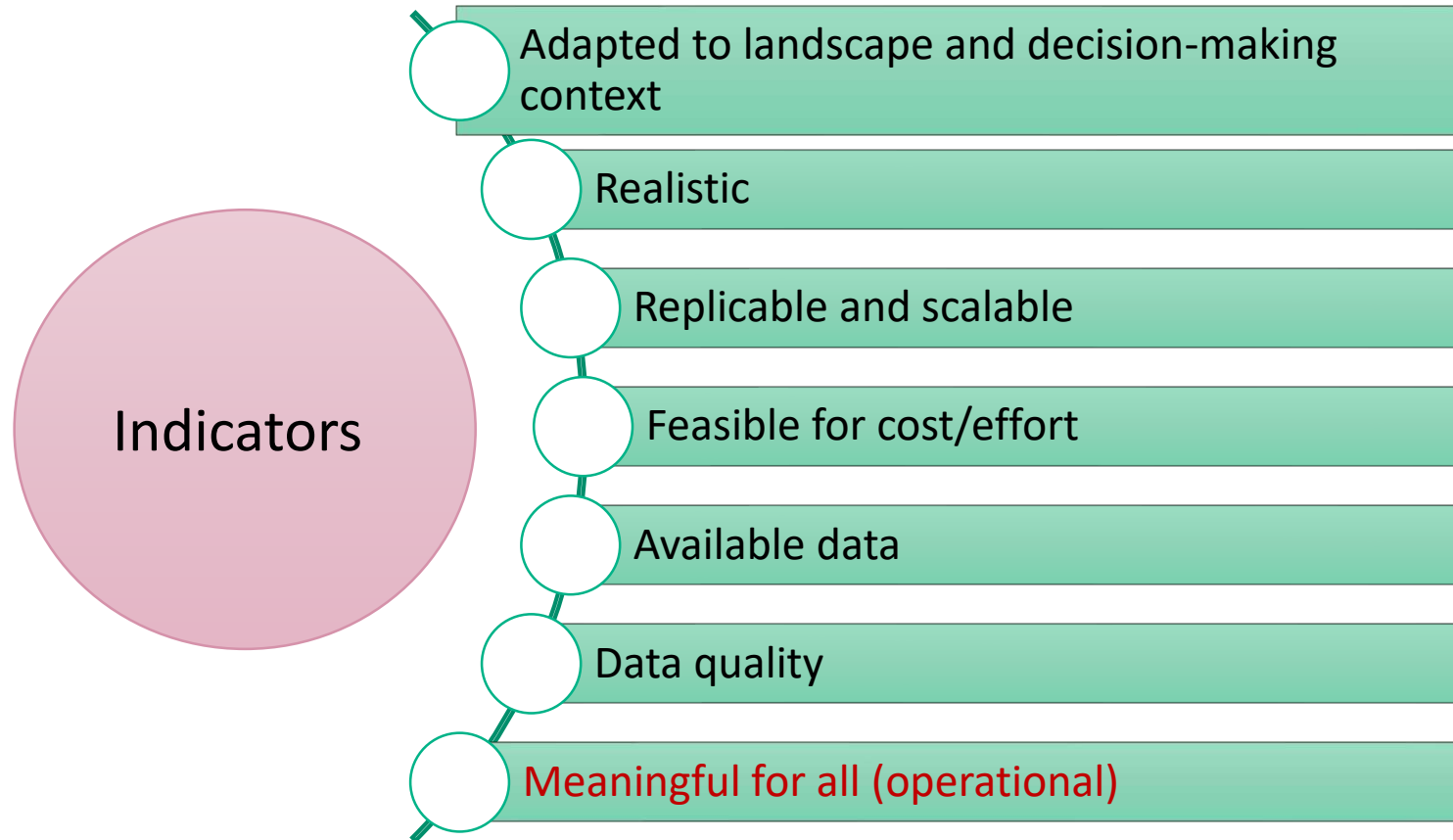


And many related concepts to assess its benefits

Knowledge on urban nature projects and where to find it



Characteristics of successful indicators



Indicators: a clearly-defined data set used to monitor progress in achieving a particular objective or target

Before collecting the data, you need to know

- (i) How will the data be collected? Will it be via literature, cartography or ecological modelling? Or will it be through existing data sets, or as field sampling?
- (ii) Which will be the data format (how is it going to be stored)?
- (iii) Who will store the data?
- (iv) Will data be open, or not?
- (v) Who are the users? Who and how can exploit the data?

If Life-Labs are interested in interoperability and comparing the data, then common criteria for scaling and valuing indicators should be set before data collection/mapping

ES demands/Participatory process

Multi-actor participation and involvement to bring evidence for NBS
planning and to create empathy around the project

Jan Gehl: “In The Last 50 Years, Architects Have Forgotten What a Good Human Scale Is”



Leave no one behind



Science-society interface

Citizens science data can make the difference

- Seeing the reality through **multiple perspectives**, cultures and locations
- Citizens as “**sensors**” – connecting communities
- **Let the trees be part of our conversation.** Fostering the uptake of knowledge on trees and their benefits



Huertos lúdicos de
Sant Vicenç dels Horts

Proyecto de restauración de
los humdales de Molins de Rei

Parque Natural
de la Serra de Collserola

Parque agrario
del Llobregat

Parque agrario
del Llobregat

Co-design and implementation of a 1st local Participatory GIS in the
Metropolitan Area of Barcelona (> 30 municipalities)
Succesful multidisciplinary team work with planners and architects



A. Start addressing/prioritizing the Challenges of Urban Green Spaces/ WHY do we need Urban Nature plans

- Biodiversity and ecosystem services loss, climate change, health, pollution, soil degradation, forest fires, fragmentation, biological invasions, water management, governance
- Difficult growing conditions of trees in urban environments
- Incomplete public understanding of the benefits provided by urban green
- Lack of skills (i.e. choice of species) and long-term strategies
- Disconnection with nature and loss of species literacy

B. Available data. Current state of nature and biodiversity

- B 1. Data on species (native vascular and invasive plants; birds; pollinators/butterflies, other).....
- B 2. Maps and/or indicators. Land cover, other? Corine? Scale and Resolution?
 - Private and public green infrastructure
 - Habitats map
 - Built-up, industrial, commercial, transport
 - Ecosystem Services maps? Maps of Ecological Connectivity? Accessibility of Green spaces?
 - Heat mapping? Pollution data? Flood risk?

B 3. Available data. Current state of processes and urban policies

- Name the initiatives, process, policies
 - Include, if existing, participatory process/citizen science
 - Add the link/web/documents
- 



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Thank you!

Corina Basnou, CREAM



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Unleashing the potential of Urban Biodiversity

Advancing Green Infrastructure in
Small and Medium Cities

Corina Basnou, Shichun Ma, Sandra Calduch, Joan Pino

CREAF

Barcelona, 16.02.2026



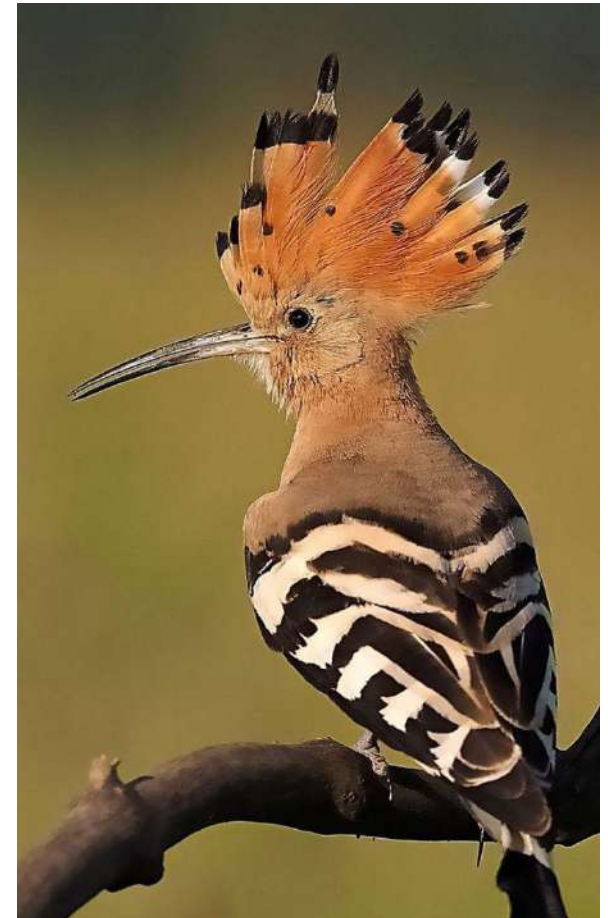
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Biodiversity at your doorsteps



Urban biodiversity

- Biodiversity encompasses genetic diversity, species diversity and ecosystem diversity, including functional diversity, which reflects differences in the biological traits of species
- Systematic studies of the urban biodiversity began in Berlin, Germany, in the 1970s, relating biodiversity to the urban form and socio-ecological characteristics



Biodiversity is not only about richness

Species variability

Abundance

Functional traits (leaf form, flowering period)

Composition

Phylogenetic group

Management

Traditions (“biocultural diversity” *sensu* Elands et al. 2019)

Challenges

Declining
engagement with
nature, extinction of
experience and
cultural literacy: the
loss of forest-related
practices
(tree hays – *frunzar*)



Land-cover changes and history

- **Urbanization** creates similar structures around the world
- Similar drivers act on the biodiversity loss and on changes in phylogenetic composition: high temperatures, high nitrogen loads, risk of biological invasions, landscape fragmentation

McKinney 2006

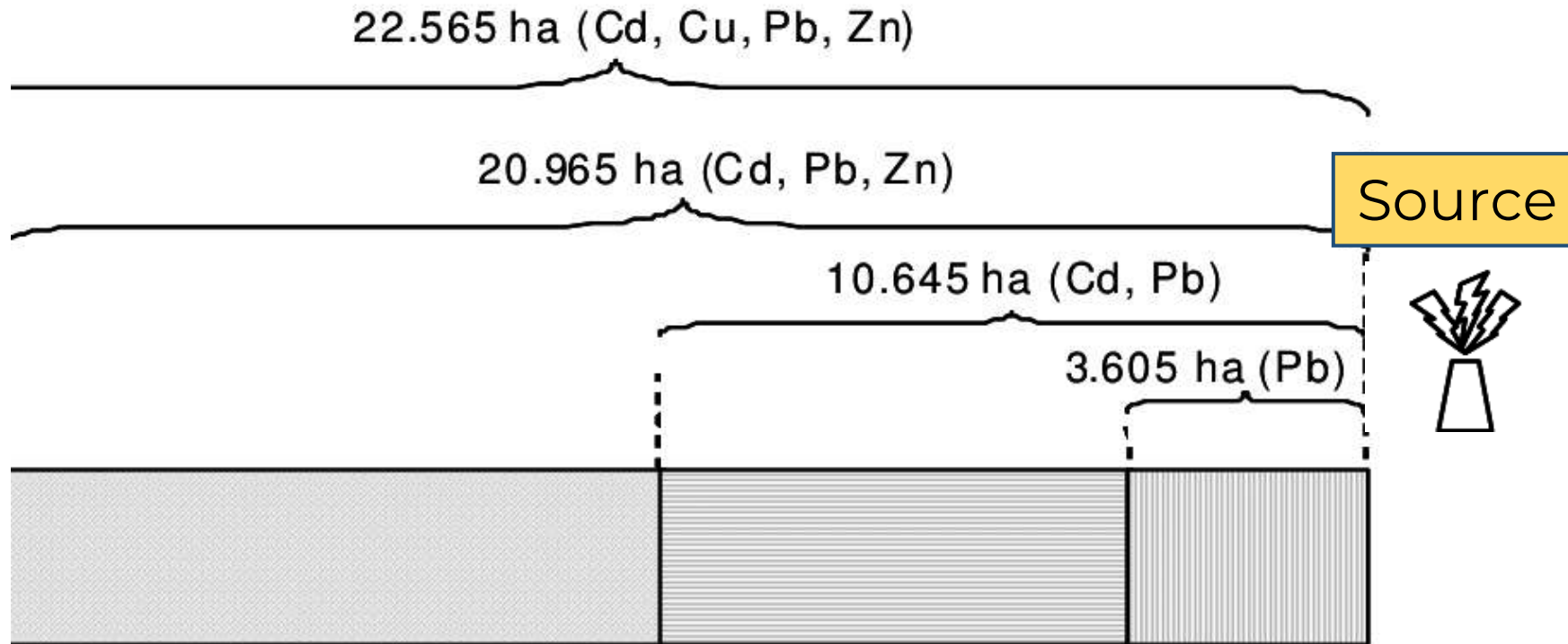


Pollution

- Air quality indicators are unclear at urban scale or national standards for some pollutants (PM_{2,5} for instance) are missing
- There is no clear evidence for a threshold below which health effects do not occur in case of most pollutants, especially for heavy metals (Cadmium, Lead etc)



Pollutants: stable and persistent



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Lăcătușu et al. 1996, Applied Geochemistry

Plants, well-being and health

- Plants in urban gardens as “air quality sensors”
- Heavy metals monitoring in leaves
- Cheaper alternatives
- Promising key research and high impact on EU policies (“Zero pollution” target)



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Biodiversity needs a cross-sectorial approach in cities

- Urban policies should move towards cross-sectional approaches that coordinate planning for biodiversity and green spaces with sectors such as health, education, urban planning and design

Kowarik et al. 2025, Nat Rev Biodiv



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Climate change

Many species will encounter novel conditions they have not experienced before in their evolutionary history

These conditions can create mismatches between their traits and the environment or between species interactions (i.e. flowering period, drought related mortality)



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Functional diversity

Knowledge on different **functional traits** is useful for research on mechanisms that help a plant cope with given environmental conditions (e.g. grazing, fire, drought etc).

De Bello al. 2005, Journal of Applied Ecology



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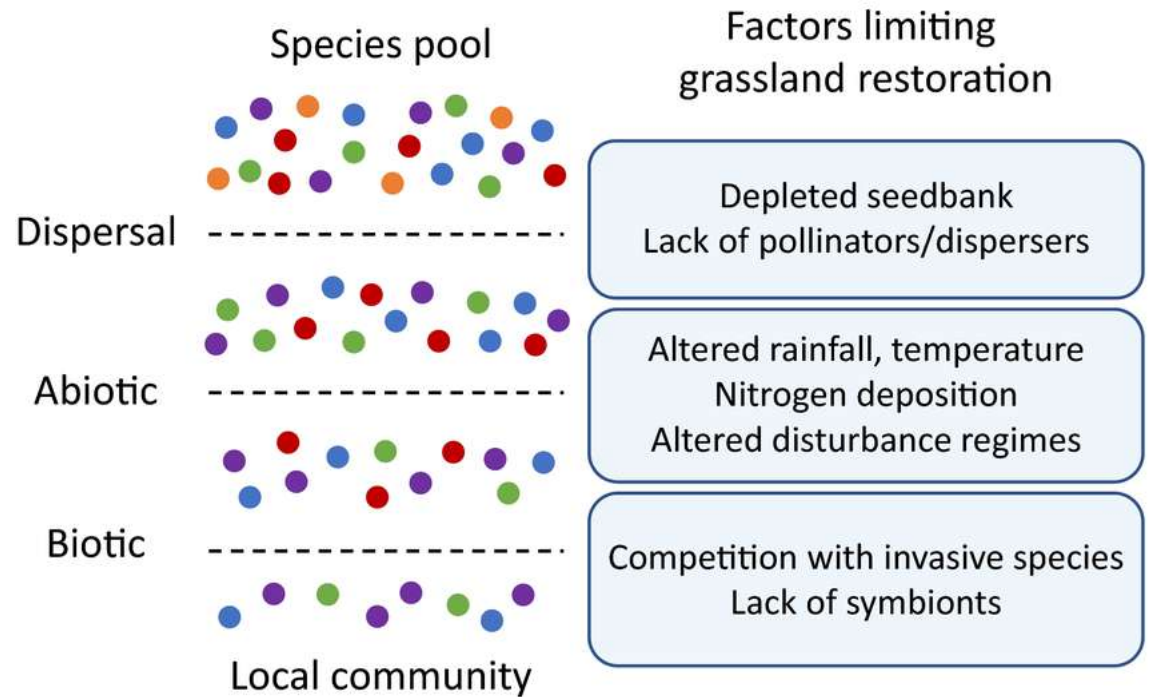
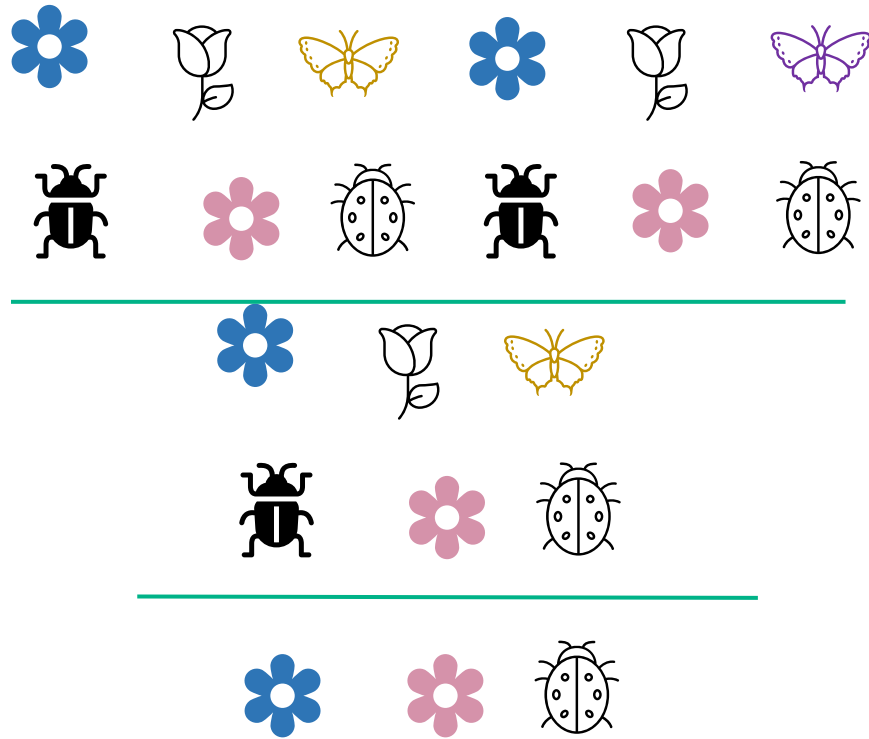


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“Nature in a small pot” (Joan Pino)

- Urban areas have a particular nature. Urban ecosystems are dominated by generalist species, including many non-native species
- Difficult growing conditions in urban environments: due to pollutants, high temperatures, drought and inundation, limited space, poor soil quality, increase susceptibility to pests

Ecological filters



Funk 2021, Journal of Ecology



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Grey vs green, green vs biodiversity-friendly and inclusive



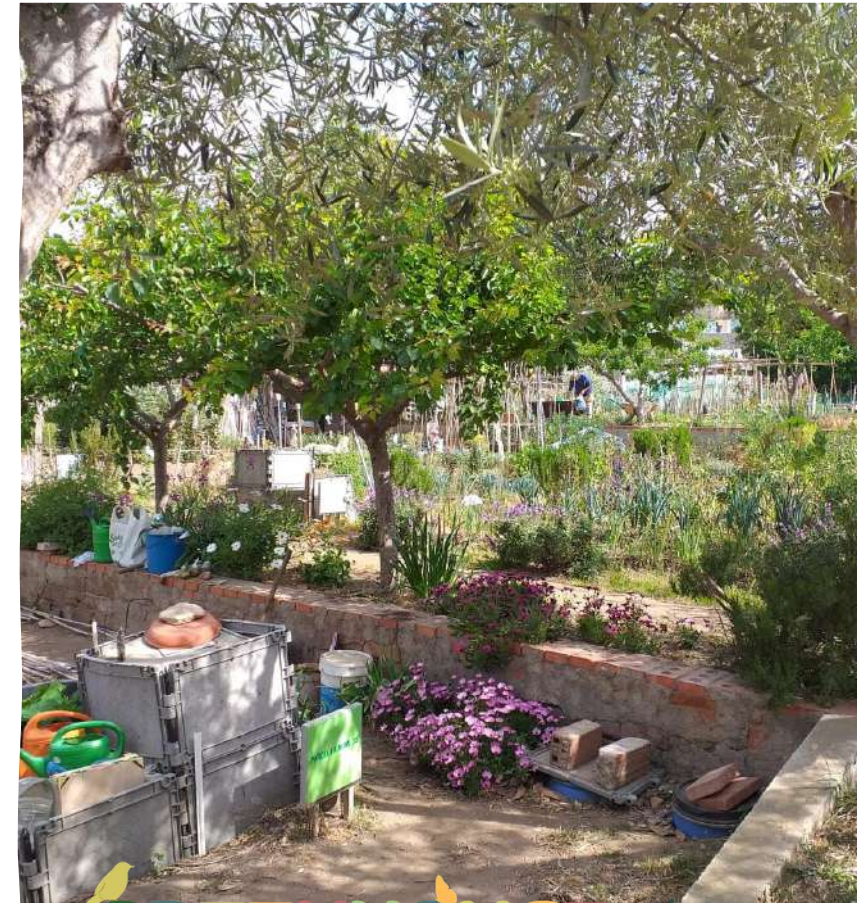
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Urban gardens as hotspots of urban biodiversity/social filter



The city as a pollinators refugee – tree pits in Barcelona



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Which species live in our garden/city?

How can we take advantage of this particular urban nature, while trying to restore and maintain local biodiversity and its ecological functions as most as possible?



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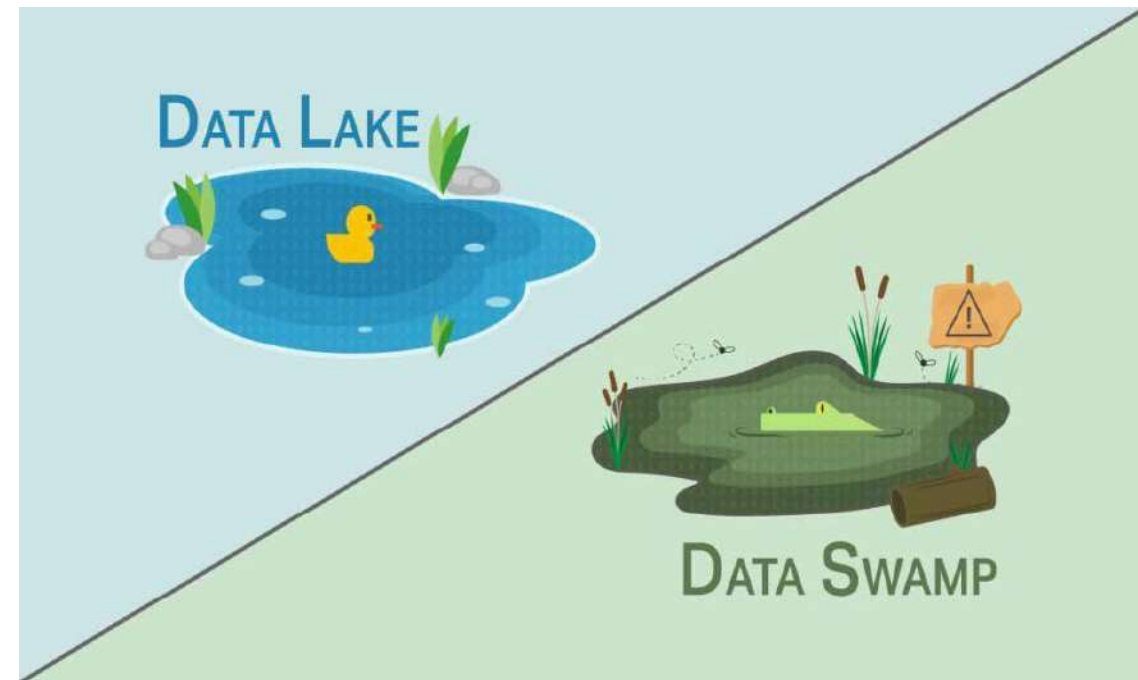
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Urban biodiversity data: understanding the importance of evidence-base for planning

- *Data Swamp* contains data which is either inaccessible to users or provides little value
- Poor data quality and not meaningful for planning (i.e. indicators with scarce data, or “no data”)



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The Biodiversity Atlas of Barcelona (*Data Lake*)

- A georeferred and open-access data base of urban species in the city of Barcelona, implemented in 2019 by the City Council



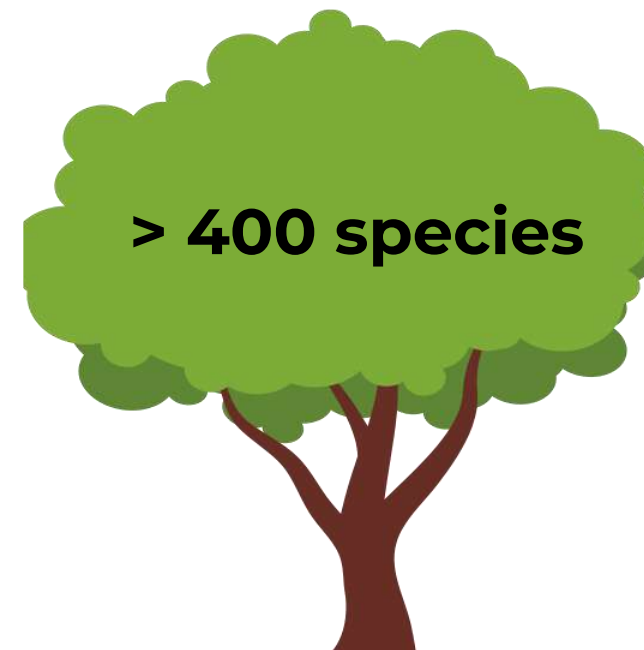
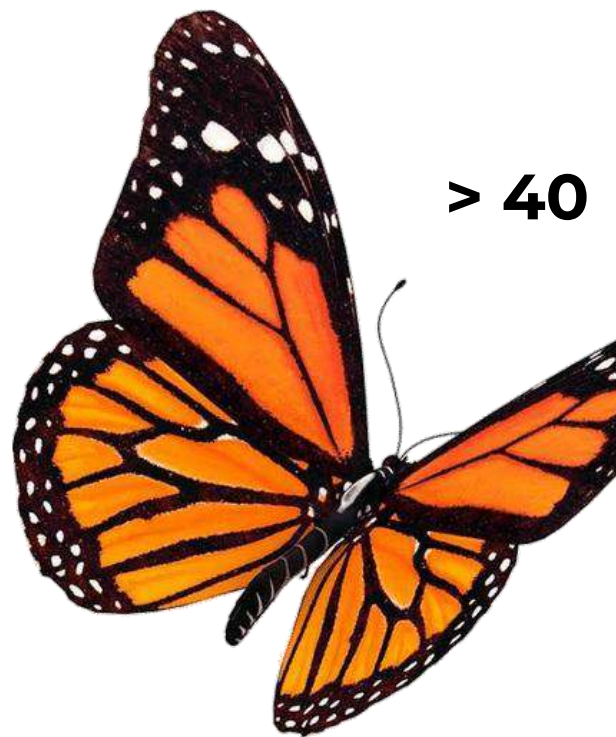
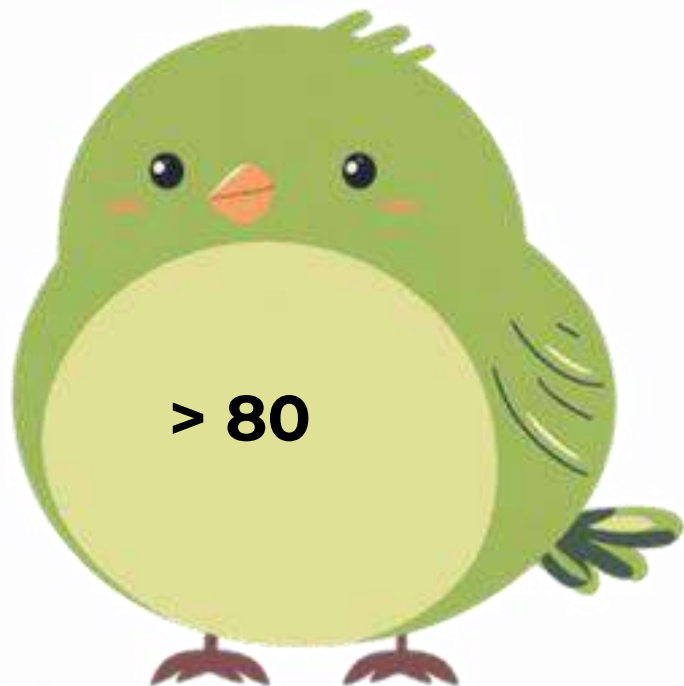
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Species richness and composition in Barcelona



<https://ajuntament.barcelona.cat/atlesbiodiversitat/en/>



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SHOW ON MAP

Other vertebrates

Naturalised ponds

Plant communities

Grasslands

Meadows

Planters

Weeds in tree pits
65 identified species

Fish

Crustaceans

Species at address

?

i



SELECTED ELEMENTS INFO

CARRER DEL CARME 47 - 49

Weeds in tree pits

65 identified species

Search for an specimen

Annual meadow-grass
Poa annua

Annual mugwort
Artemisia annua

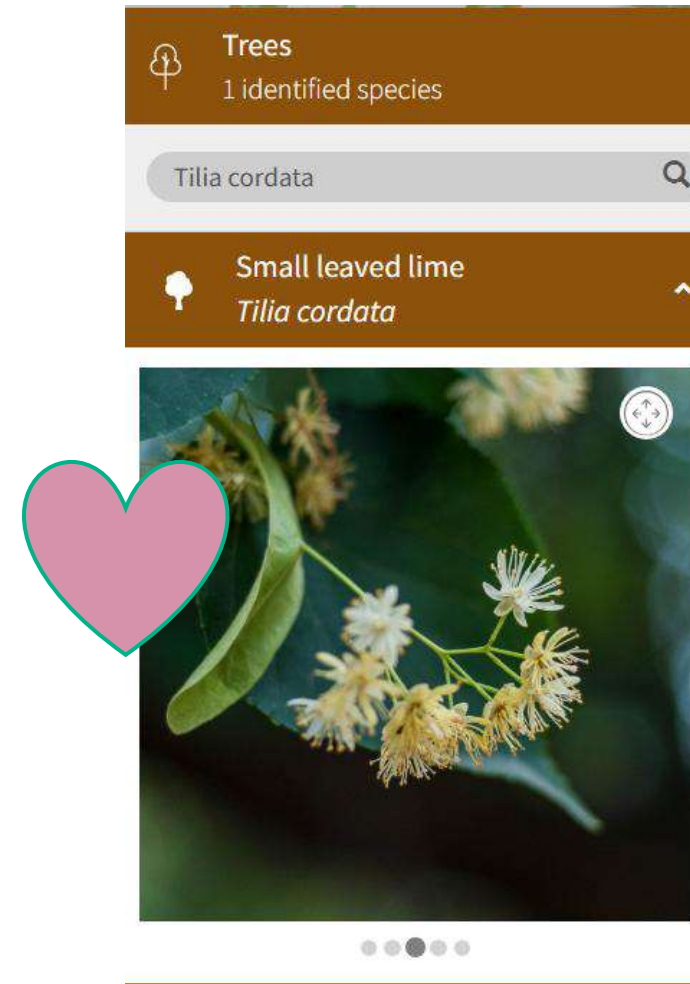
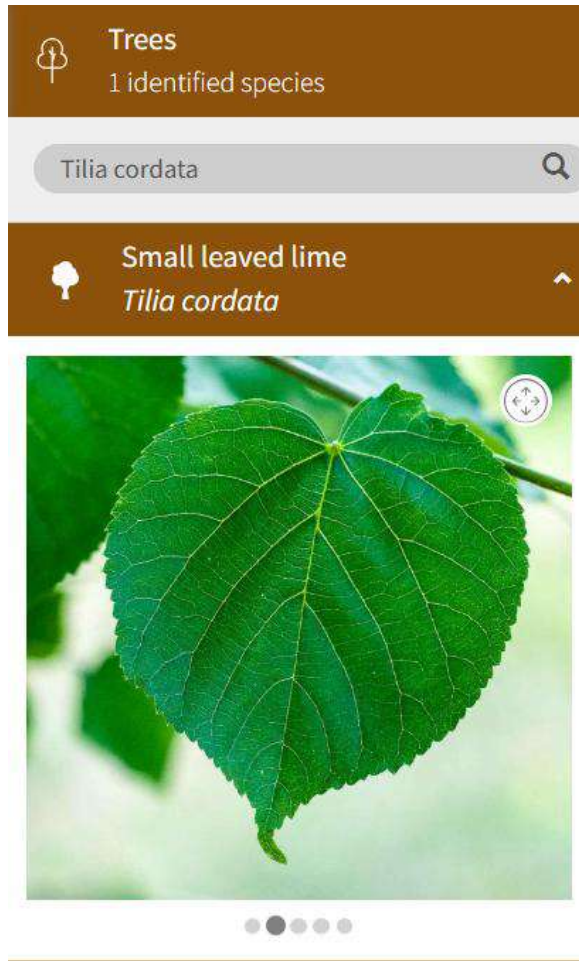
Bachelor's button
Anacyclus valentinus

Bermuda buttercup
Oxalis pes-caprae

Black Medick
Medicago lupulina

Black nightshade
Solanum nigrum

Functional traits



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A data base providing new research on the *Smellscape* provided by urban forest in Barcelona...

Shichun Ma, PhD student

CREAF



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Thank you!

Corina Basnou



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From Open Data to Planning Action

An interactive map of scented trees from the
Biodiversity Atlas

Shichun Ma



One overlooked point

Smell is associated with

- Emotion
- Memory
- Stress

yet remains largely ignored in urban planning.

So why don't we map it?

Hedblom et al., 2019; Spence et al., 2020

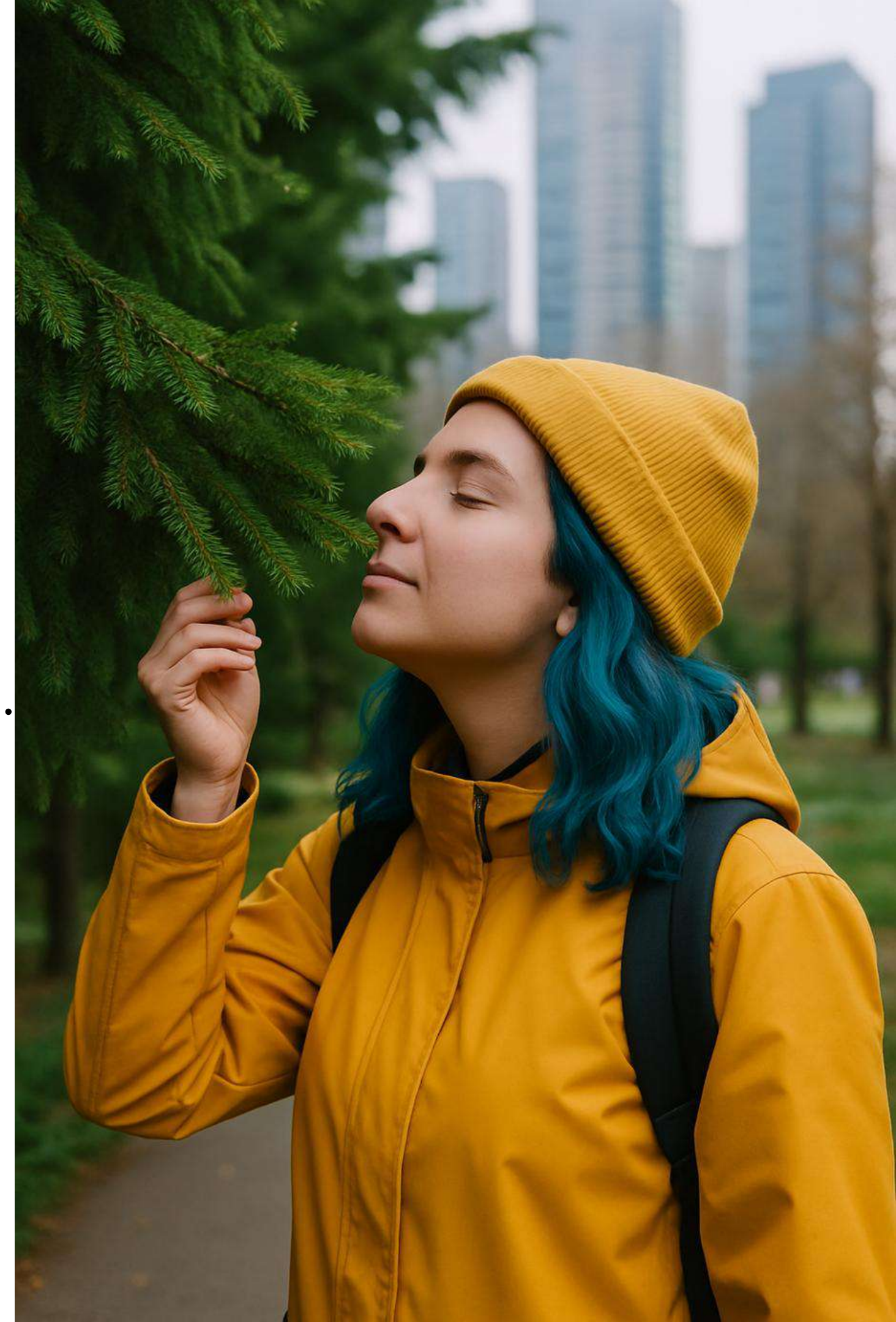


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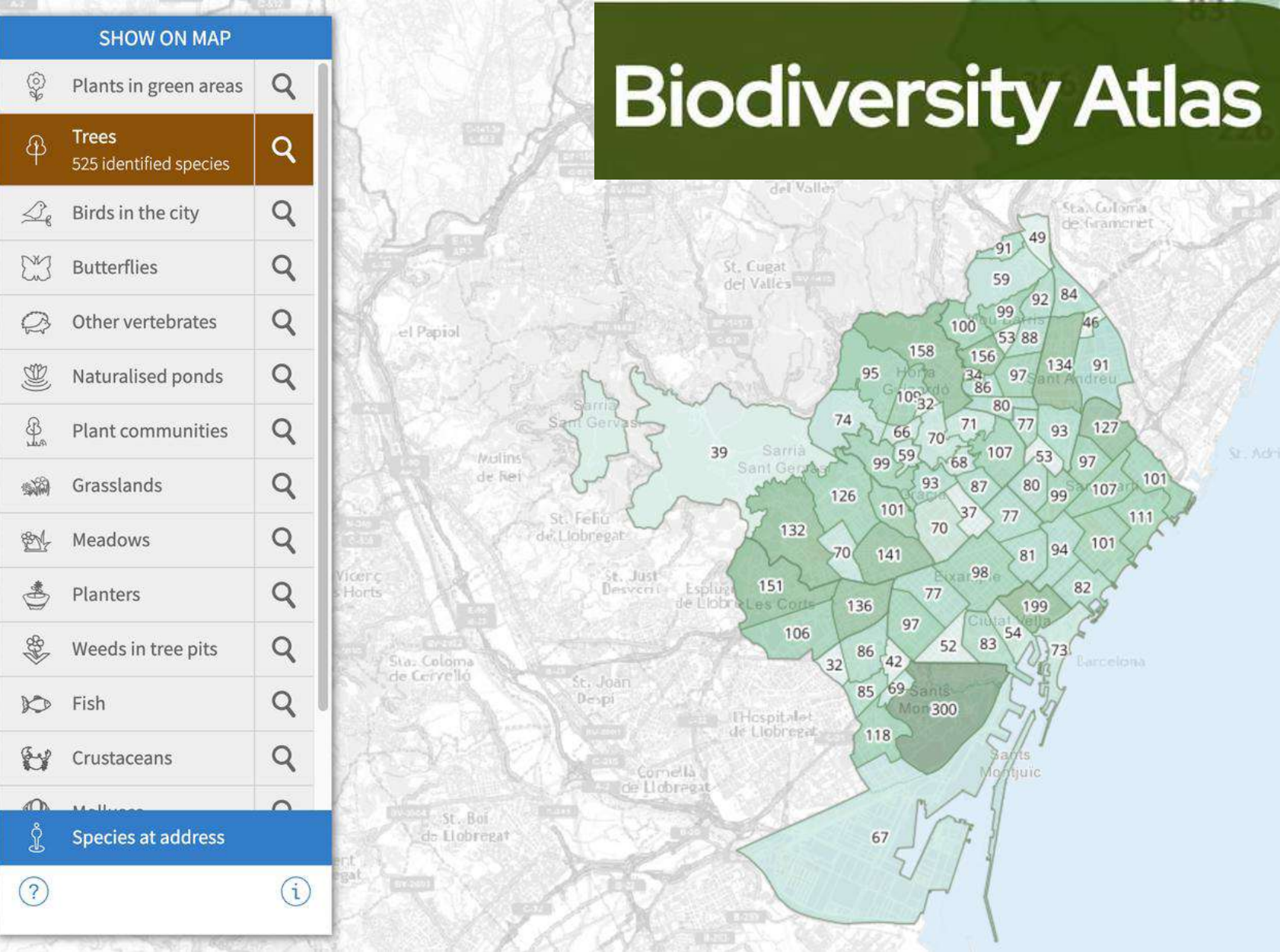
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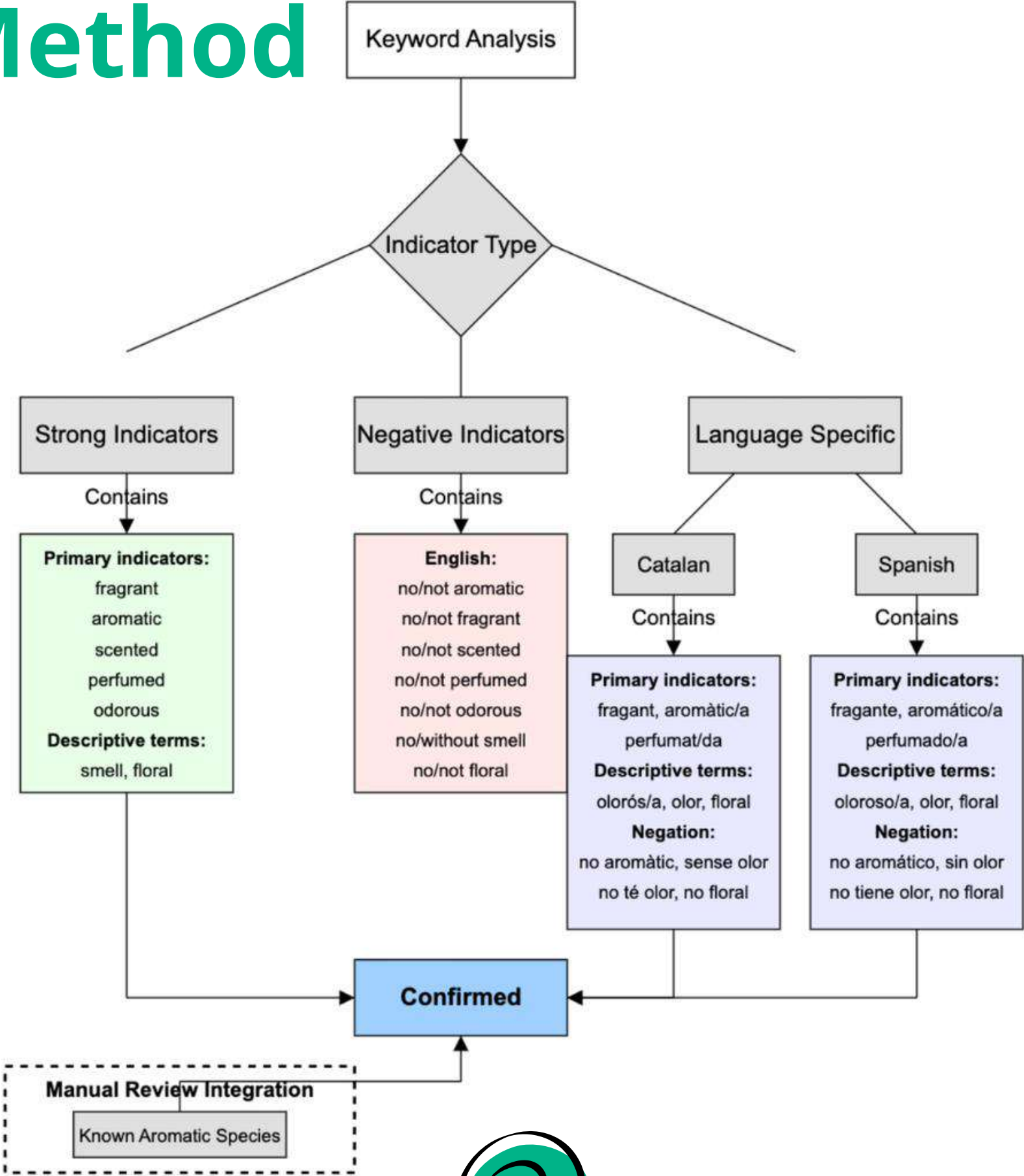
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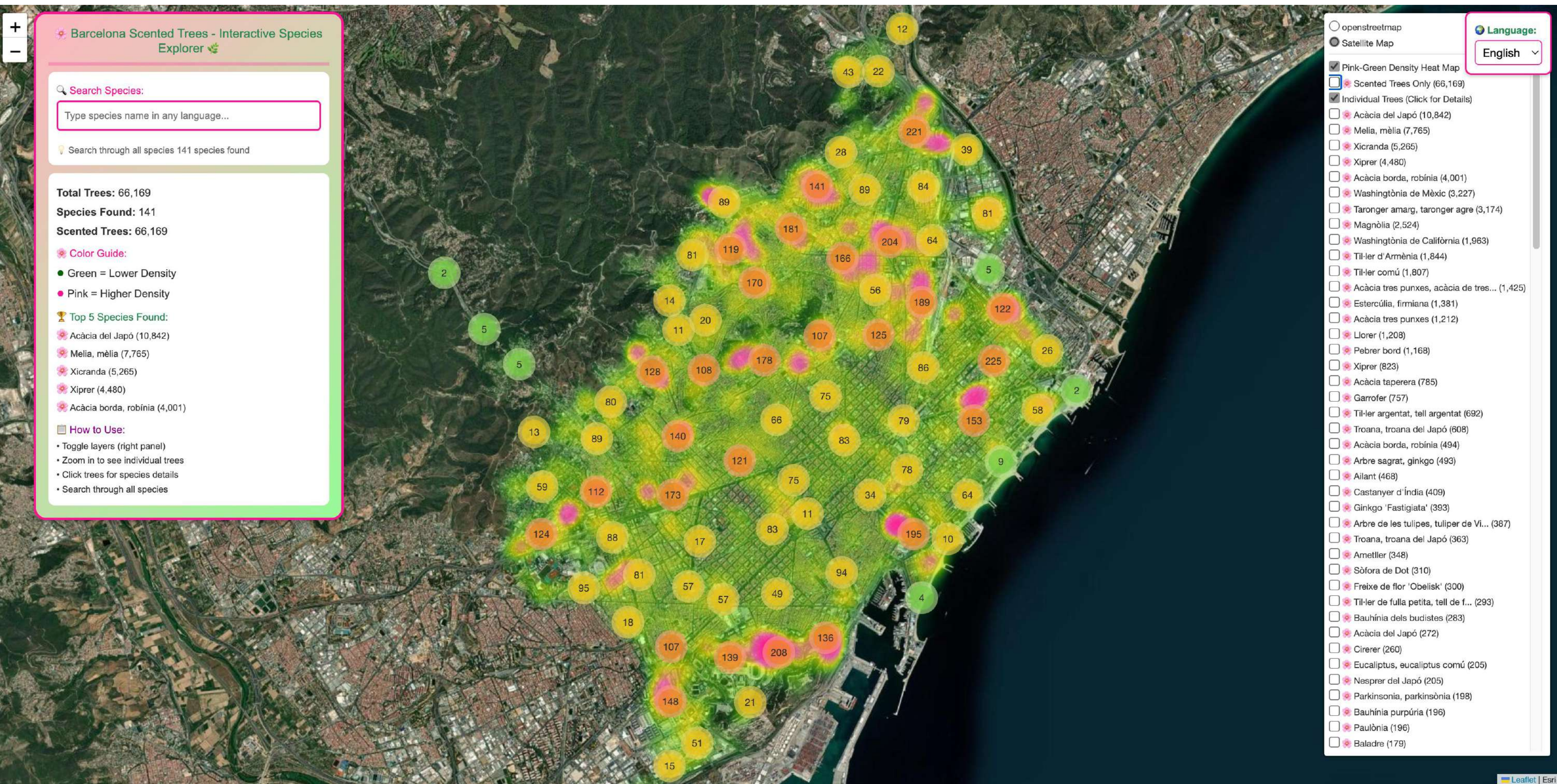
A Pioneering Multi-scaled Method



1

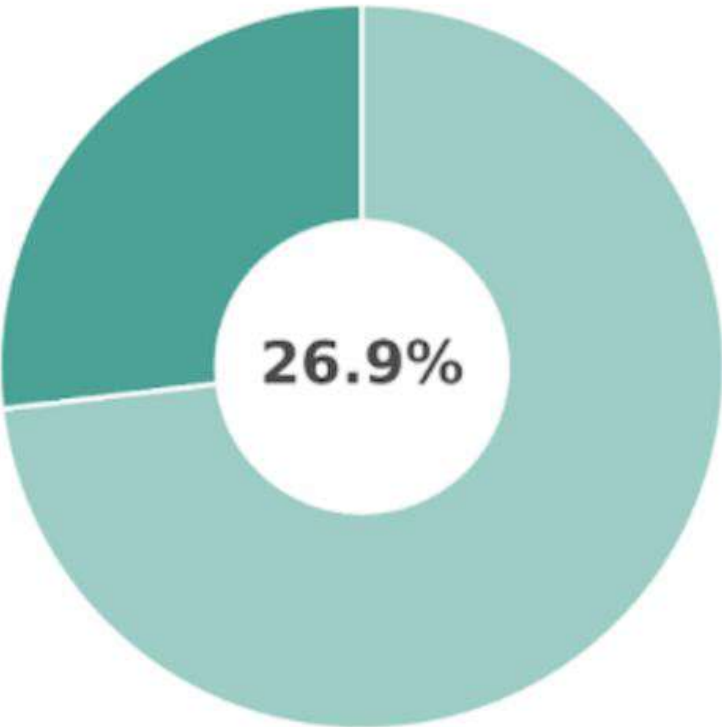


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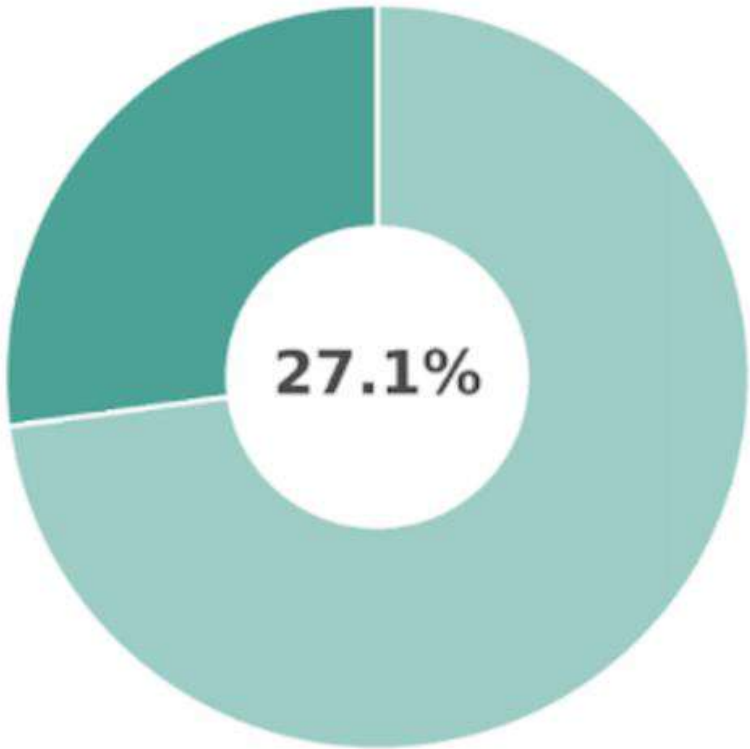


[Smellscape Map in Barcelona](#)

Results



141 scented species
out of 525 total species



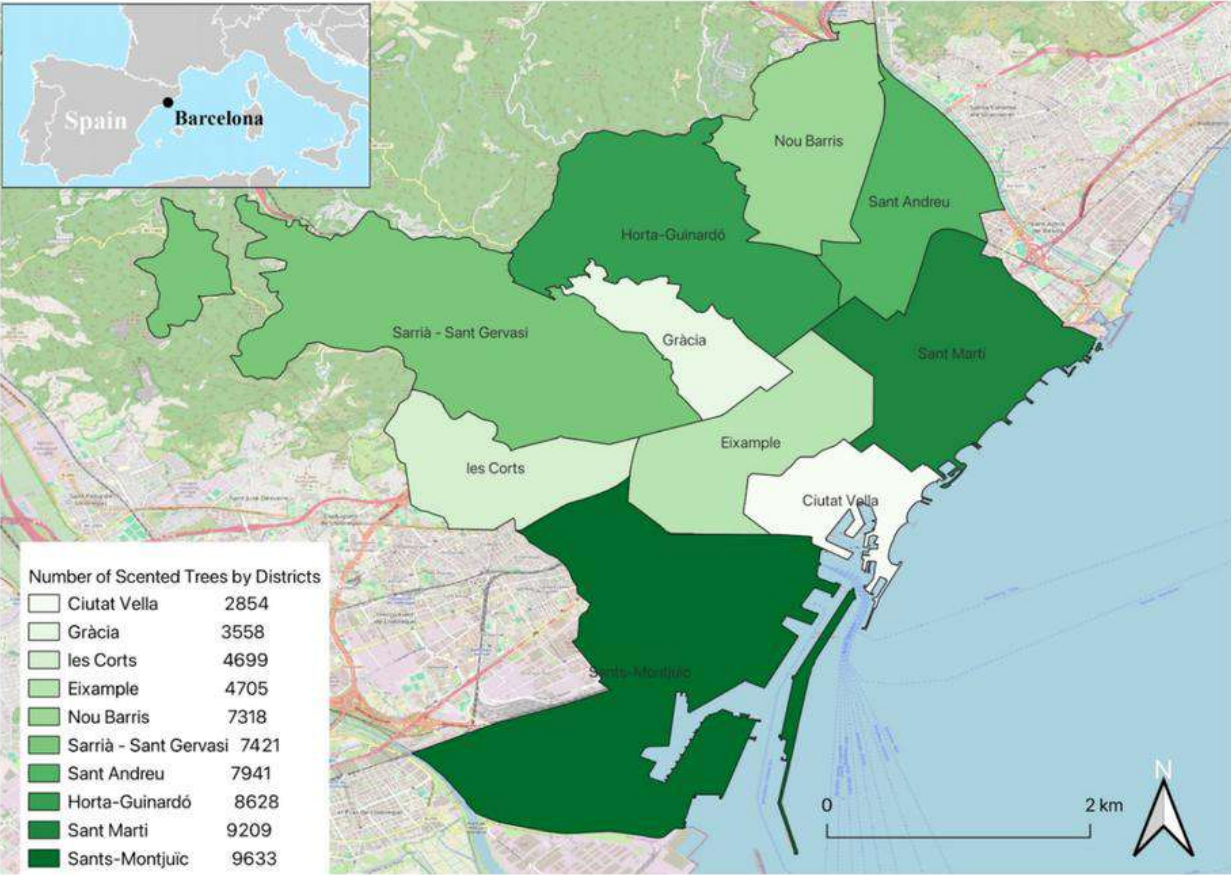
66,169 scented trees
out of 243,999 total trees



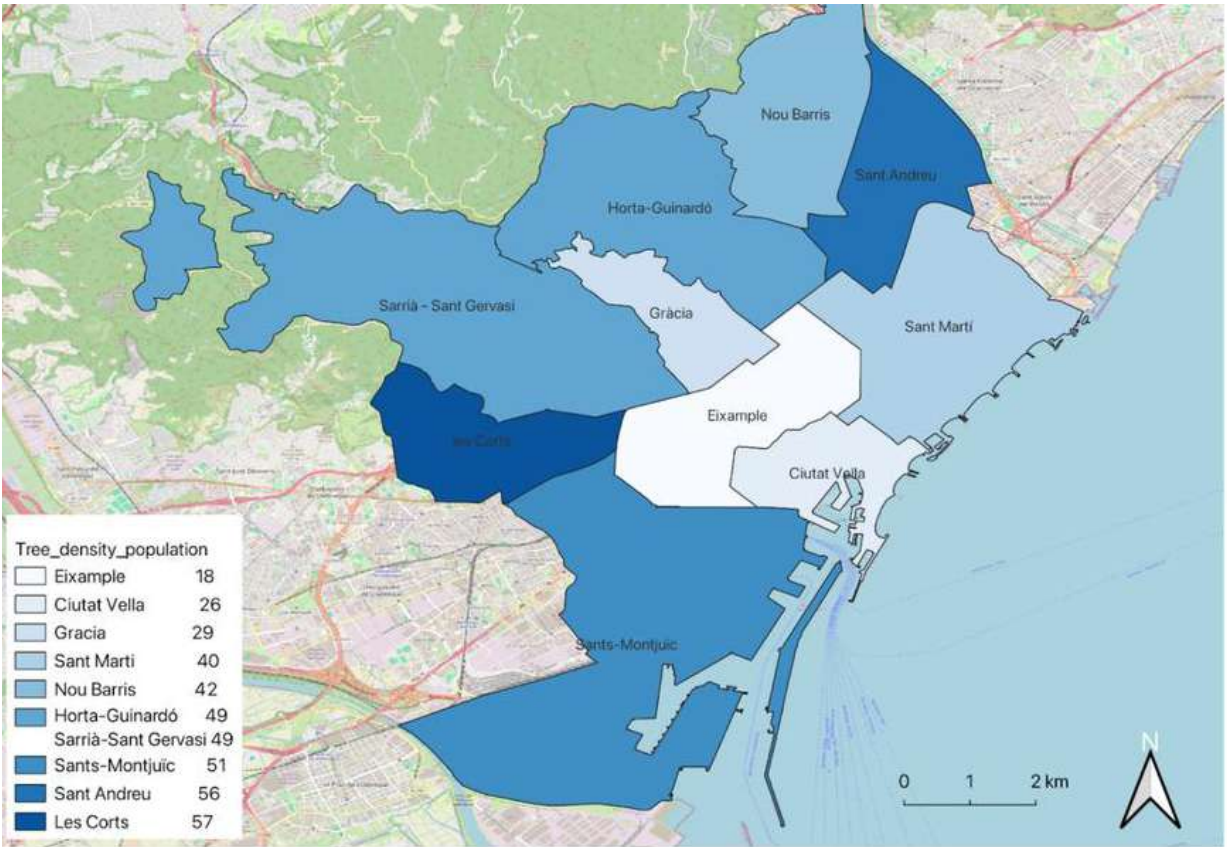
styphnolobium japonicum



melia azedarach



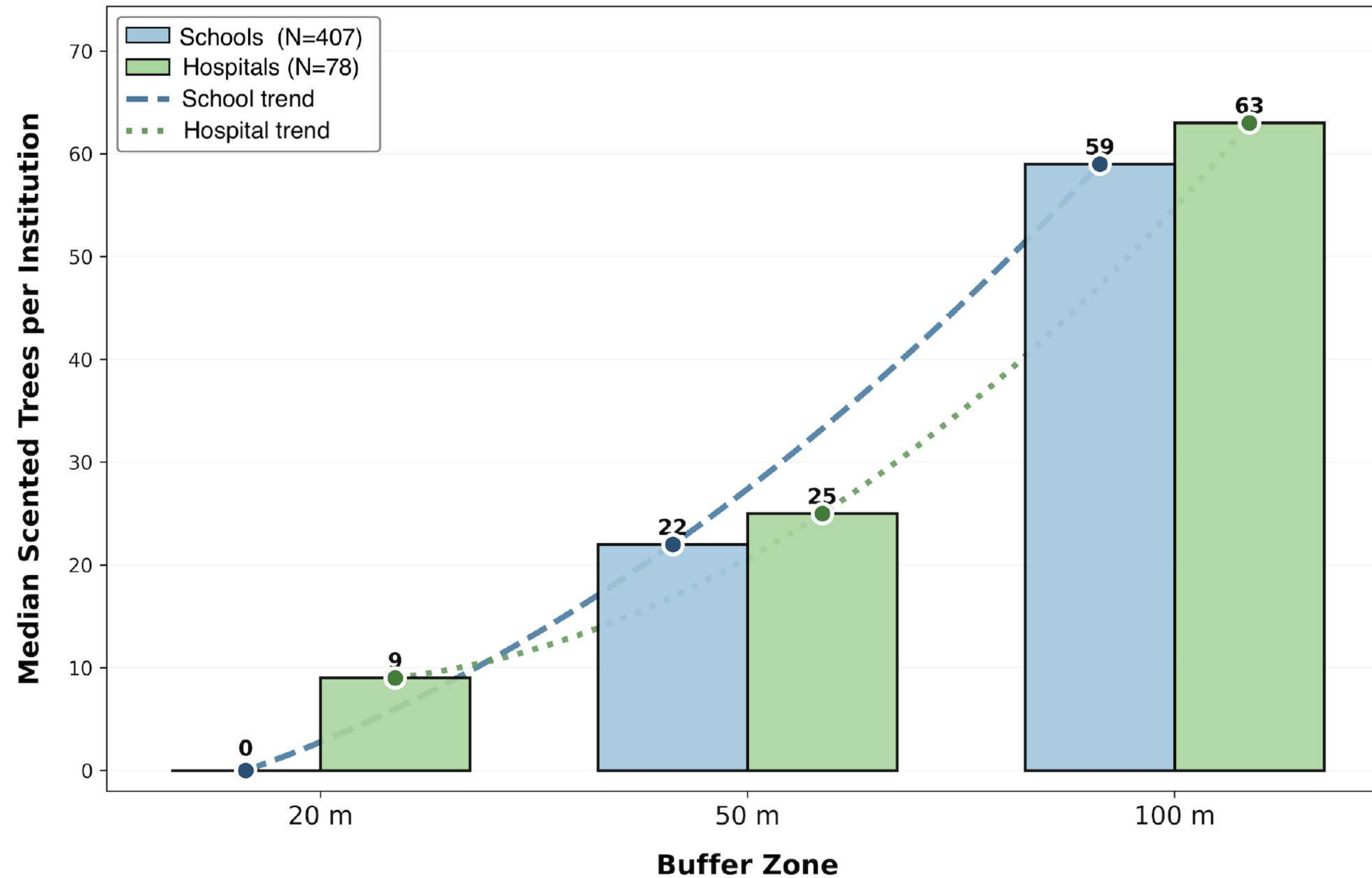
Number of Scented Trees by District



Scented Tree Density per 1,000 People by District

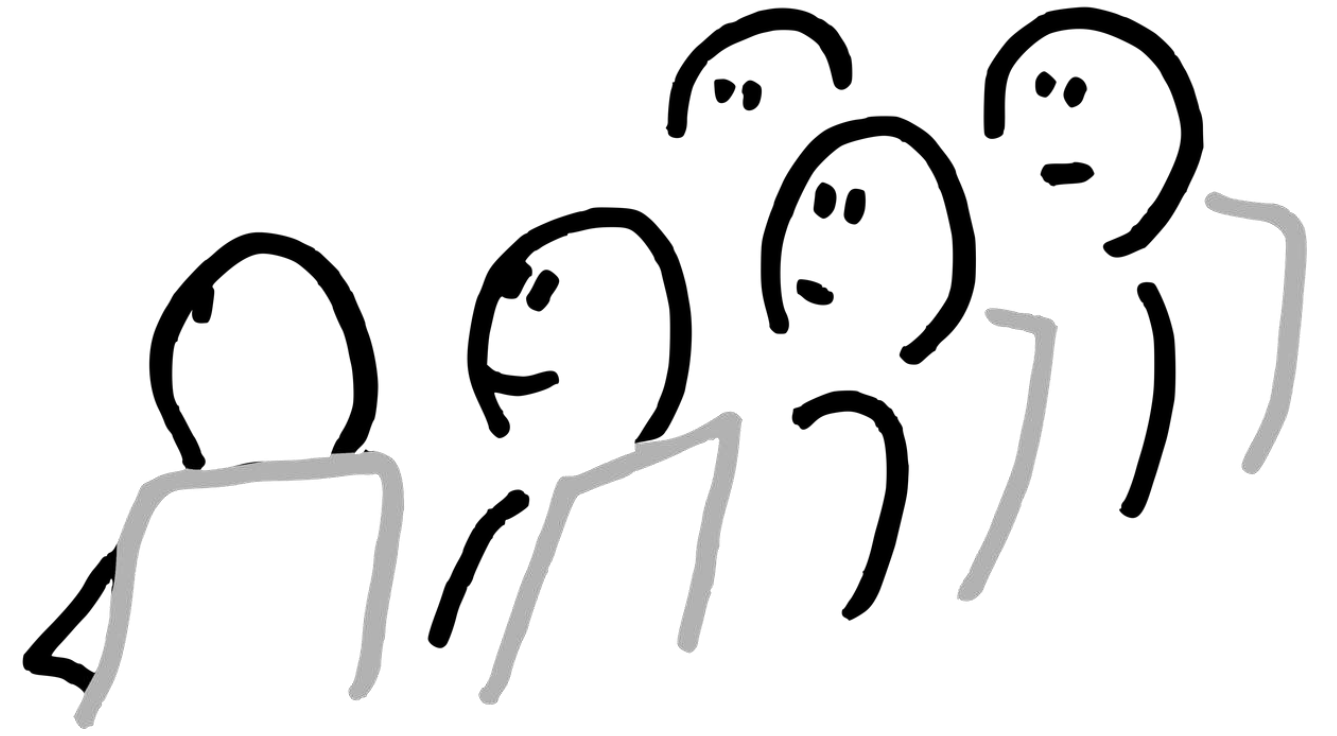
Results

Median Scented Trees in Hospital and School Buffers





Questions ?



Flower smellscape
Barcelona

Transferability

Very briefly: transferability depends on the data baseline.

If a city has a basic tree inventory, the workflow can be replicated directly.

If data is partial, start with a pilot (e.g., school area)

If data is limited, a rapid survey or citizen reporting can help build a minimal usable dataset.



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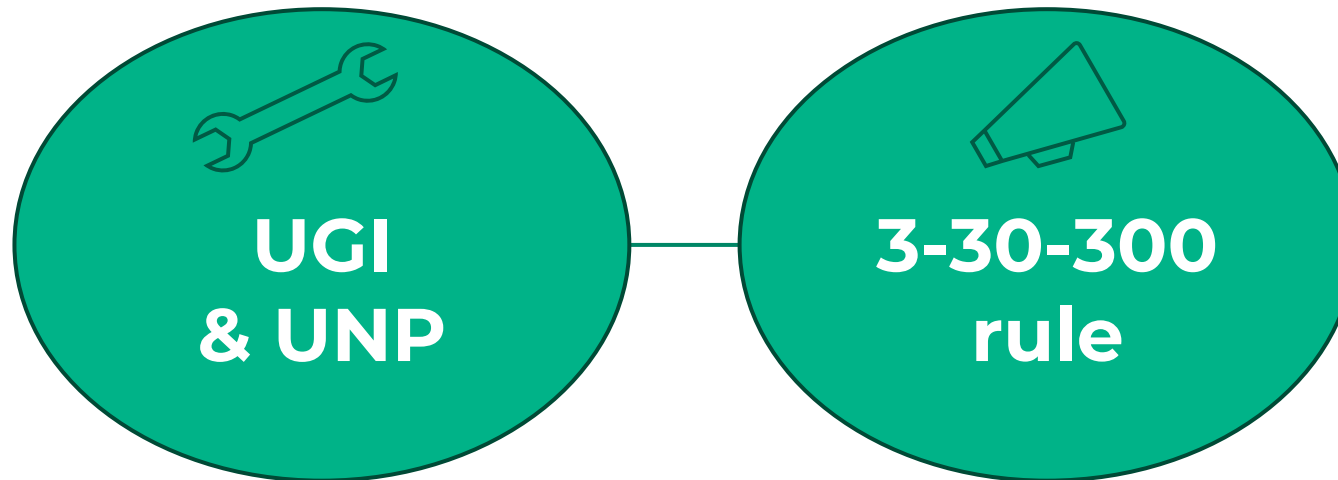
Advancing Green Infrastructure in
Small and Medium Cities

WP 1 – 3rd Partner meeting

Barcelona, 18.2.2026

Regreening cities

How to integrate nature into cities?



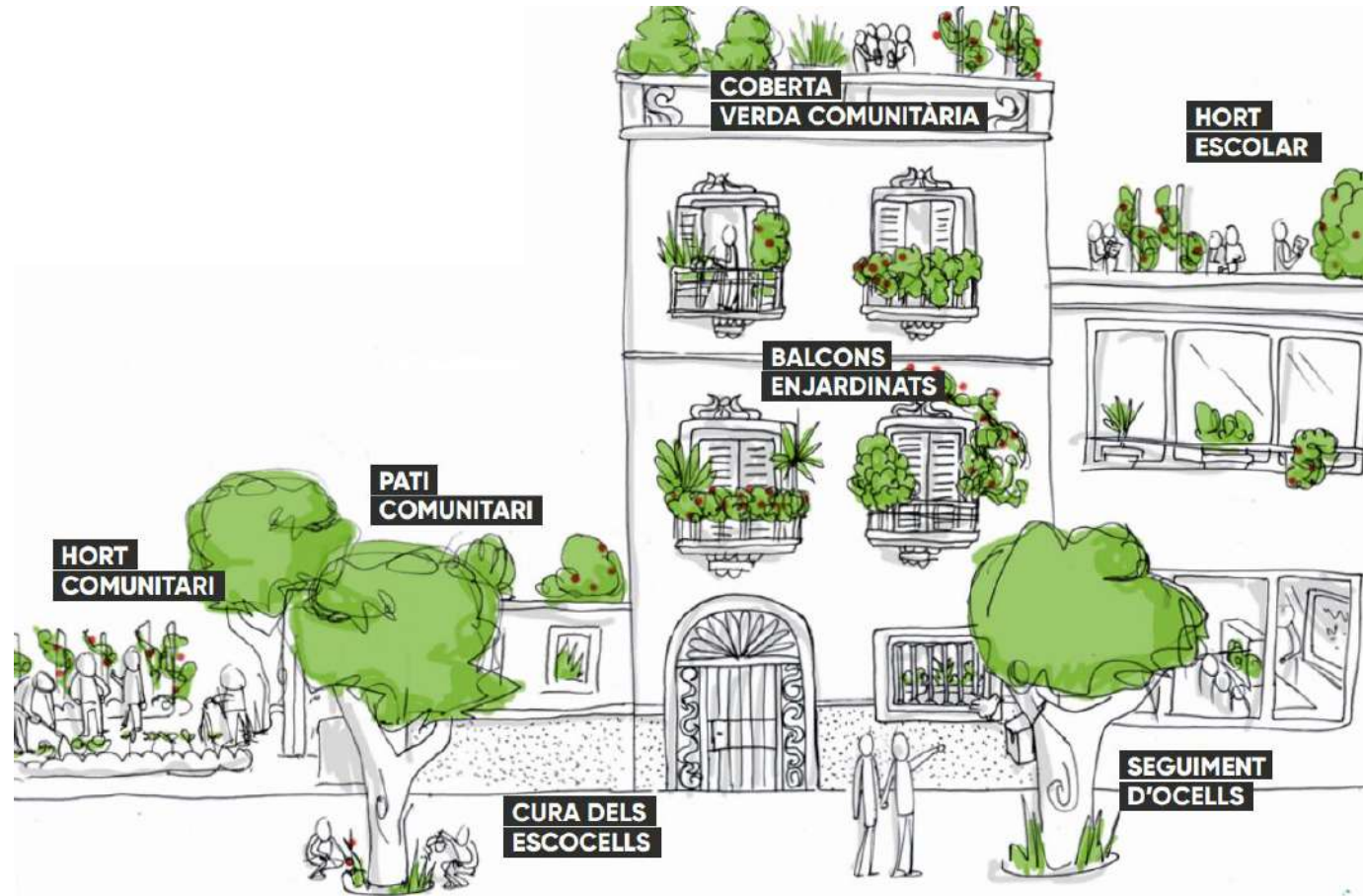
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Urban Green Infrastructure (UGI)



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[Barcelona Urban Green Infrastructure boost programme 2017-2030](#)

UGI – Green urban corridors



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Avinguda Meridiana, Barcelona

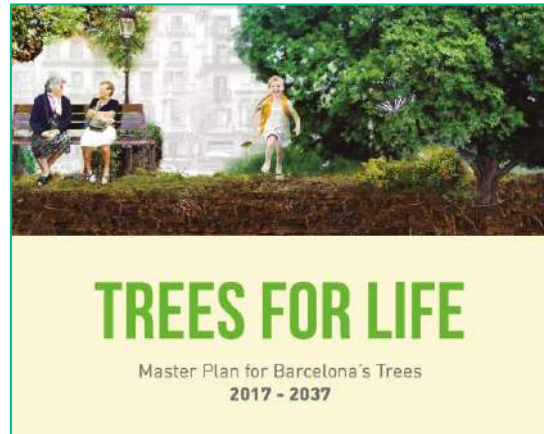
Barcelona green plans

[Barcelona Trees management Plan \(2008\)](#)



[Barcelona Green Infrastructure & Biodiversity Plan 2020 \(2013\)](#)

[Barcelona Urban Green Infrastructure boost programme \(2017\)](#)



[Barcelona Trees master Plan 2017-2037 \(2017\)](#)



[Barcelona Nature Plan 2021-2030 \(2021\)](#)



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Storytelling

the 3-30-300 rule:



3 trees
from your
window

Visibility



Exposure



300m to
nearest park

Access

Konijnendijk, C. [2021](#), [2023](#).



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3-30-300 rule



Green visibility
3 trees from window

**Nearby
green
& human
health**



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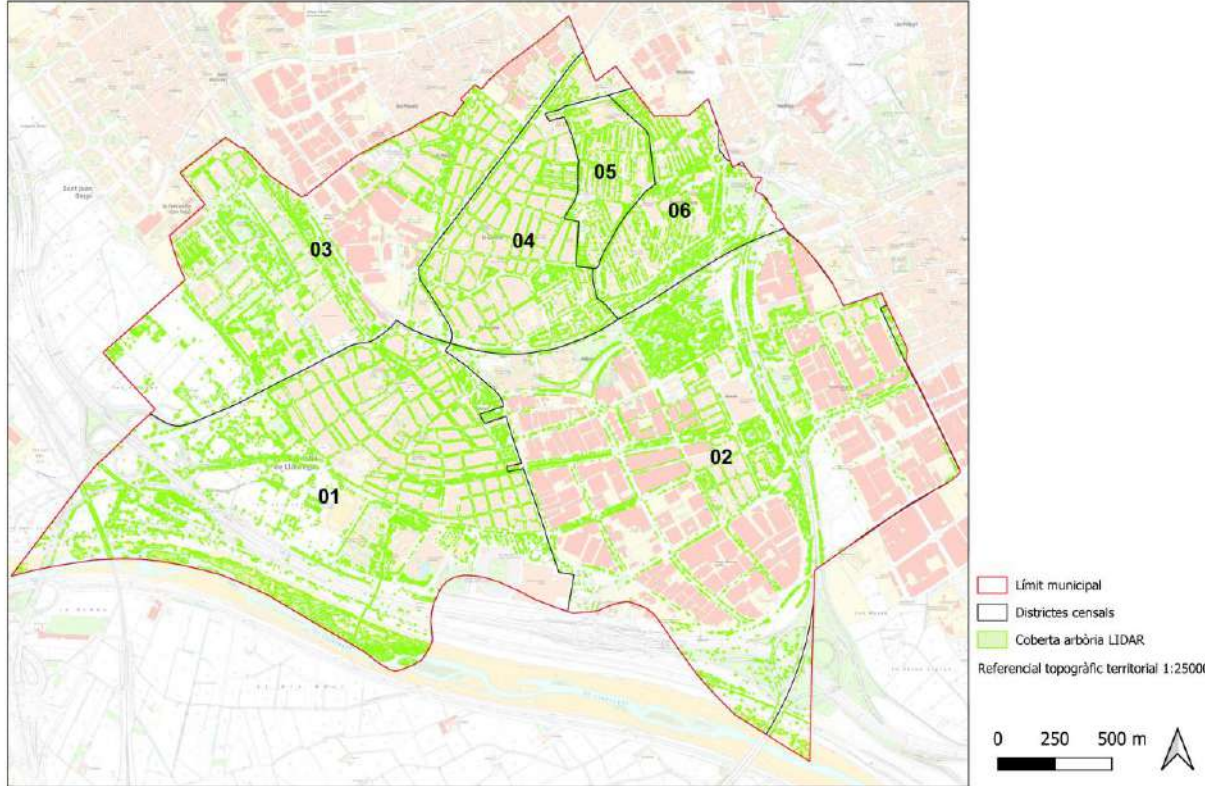
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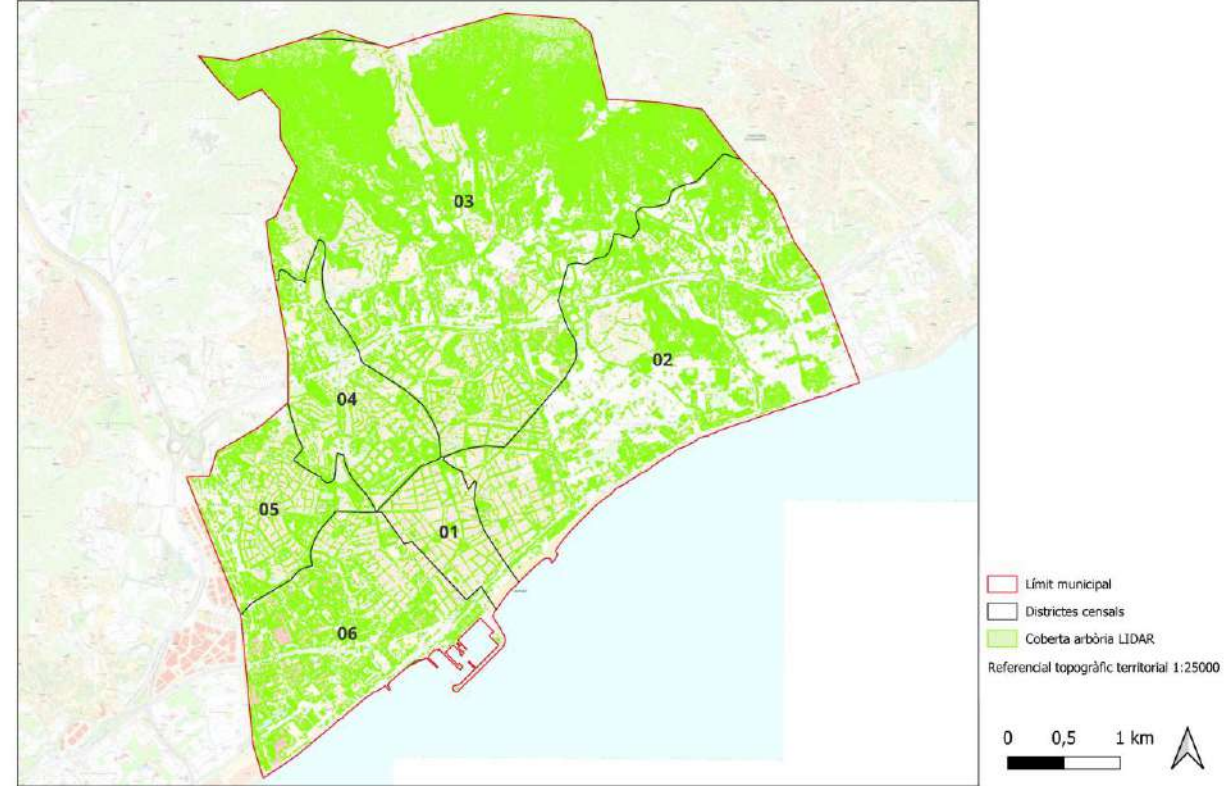
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Measuring 3-30-300 rule in Barcelona municipalities

Green exposure
30% tree canopy



Cornellà de Llobregat
Medium city (7 km², 91.589 inhab.)



Mataró
Big city (22 km², 129.749 inhab.)



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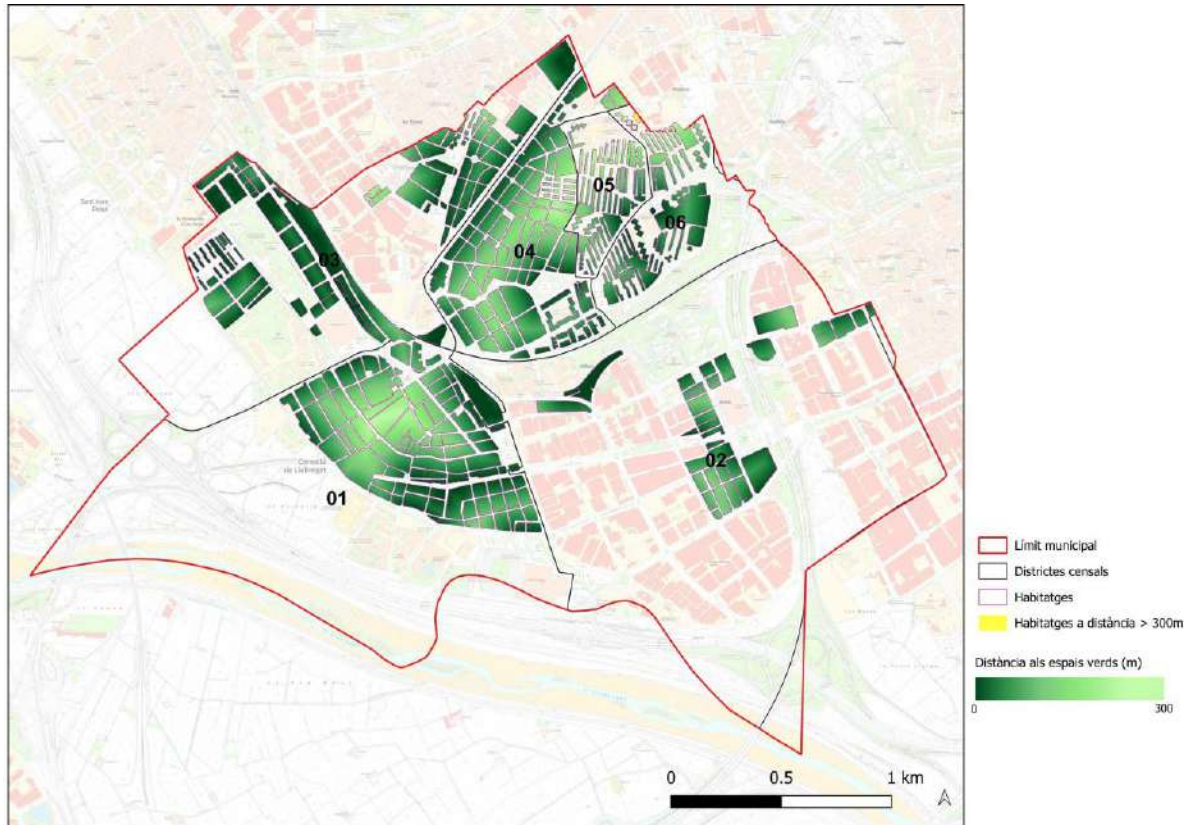
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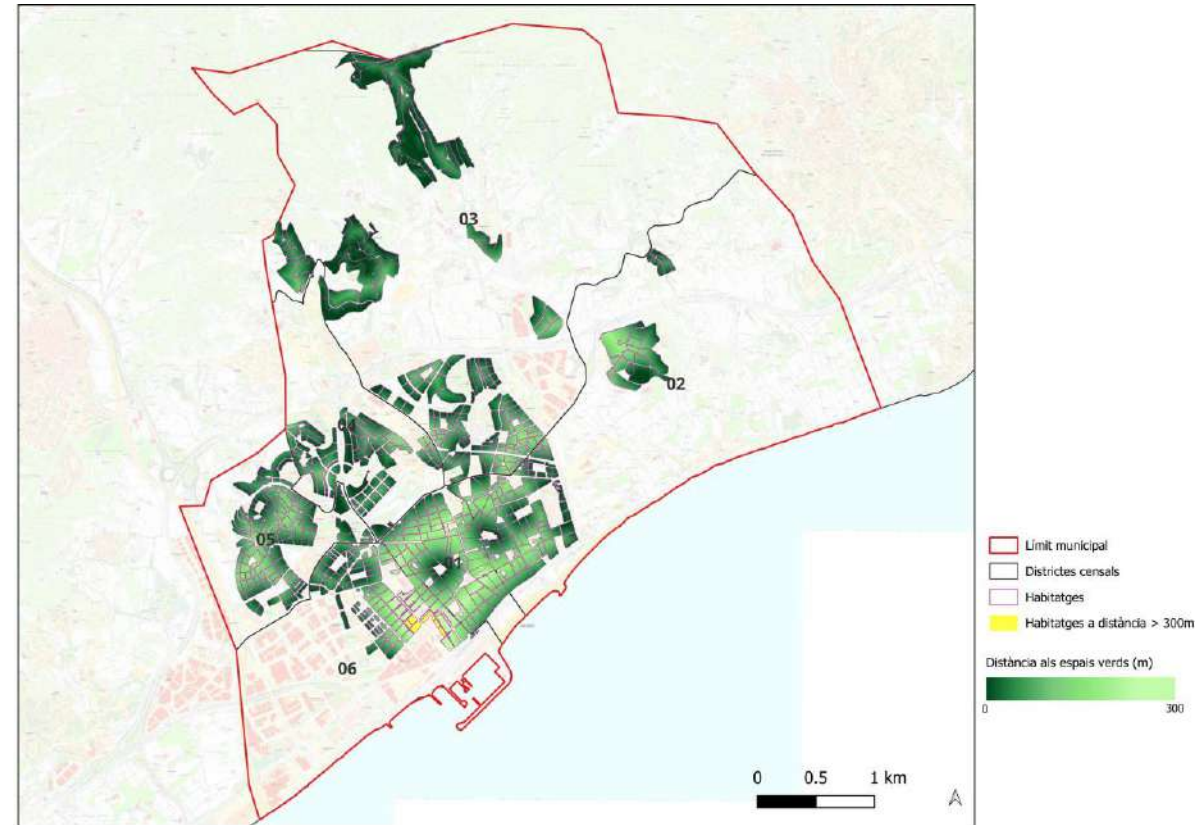
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Measuring 3-30-300 rule in Barcelona municipalities

Green access
300 m, ≥ 0.5 ha



Cornellà de Llobregat
Medium city (7 km², 91.589 inhab.)



Mataró
Big city (22 km², 129.749 inhab.)



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Thank you!

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Participation in planning and management of urban green space and NBSs implementation

1. Delivering Interactive Capacity Building Training
D.1.3.1 Training materials

Maja Simoneti and Urška Didovič, IPoP, PP2

Barcelona, 16. 2. 2026

Public participation in NBS actions

- introducing new typology and imaginary of public green space and greened areas/buildings
- new collaborators – specialists for: biodiversity, urban water management, urban heat mitigation, public health and well being, social equality and cohesion
-
- potentials of participation
- needs for participation
- interests for participation



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Key drivers for participation

- **new public governance**
 - reducing public budgets
 - engaging the citizens and new stakeholders
- **new functions of green space**
- **boosting public trust in public policies and public services**
- **raising awareness & acceptance of NBS's**
- **growing interest of citizens** in urban nature
- new participatory practices
- three levels of collaboration: political, professional, public



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New structure and images of urban green space



Wilder and temporary urban landscapes



Growing public interest for nature



New methods of participation.

Climate change: growing importance of urban green space

- biodiversity loss, threat to people life
- mitigation: carbon sink, reducing greenhouse gasses
- adaptation: cooling, flood management, resilience
- securing public health and wellbeing (close to green space & trees)
- saving energy: reducing needs for cooling and heating
- adding value of property

Cities need

- to protect biodiversity and empower urban nature
- ambitious greening and nature-based solutions
- engage public and private green areas and trees



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New mixtures of participatory actors & actions



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What is new?

- growing scope of green and greened areas
- new types of landscape designs and planting schemes: biodiversity, NBS
- growing specialization **of work tasks in planning and maintenance**
- new tasks: collaboration with land-owners, residents, NGO's & civil society
- more **professional expertise** for planning and management
- more **financial resources** for planning, construction, and **maintenance** needed
- **early and sufficient enough collaboration of local actors**
 - to protect and engage the potential of urban nature and greenery
 - to meet social needs of local community
 - to adapt and raise resilience of local environment



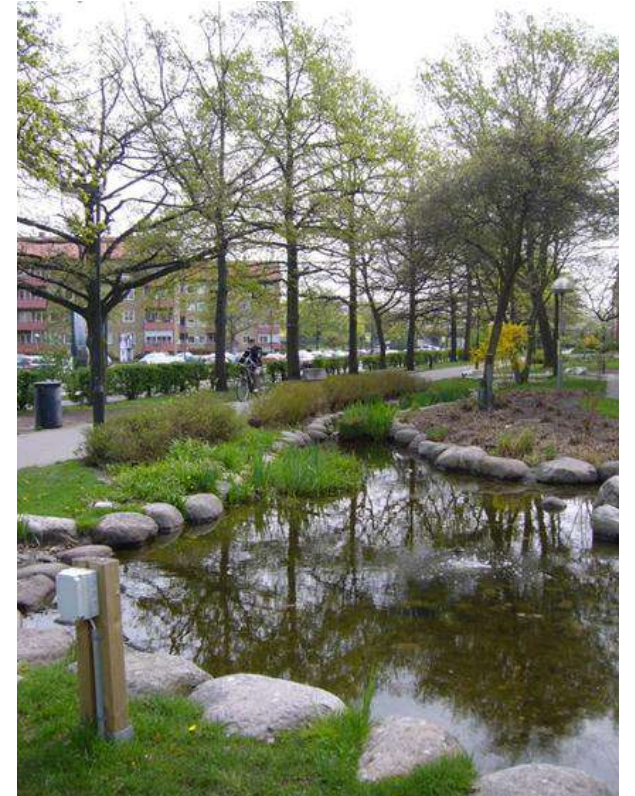
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Meaningful participation – understanding, collaborating



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Main points in our project

- empowering early + meaningful collaboration
- raising awareness about biodiversity loss + NBS

Meeting social **needs of local community**
and ensuring adaptation to climate change.

- long-term **planning and management** strategies
- collaborative practice of **maintenance**



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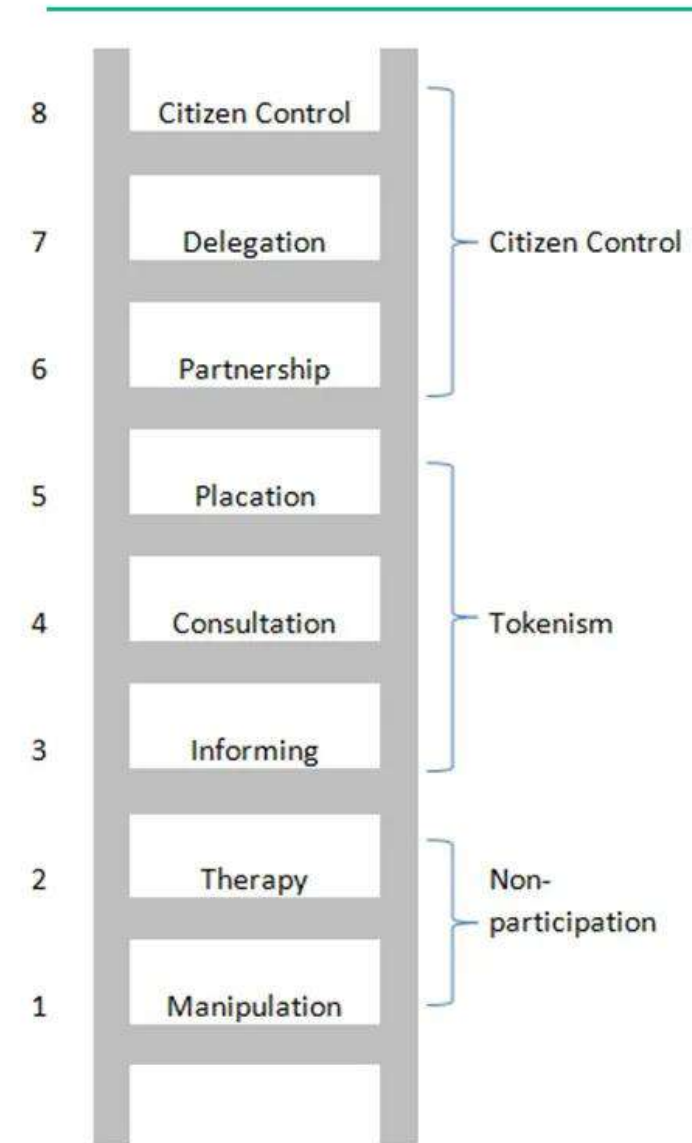
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Enabling genuine contact with nature and other people



Types of participation

- formal (obligatory) – **informal**
- indirect / passive – **direct / active**
- **guided** – spontaneous
- informing
- collaboration
- co-creation
- empowerment



Arnstein's ladder of levels of participation

Figure by Katrin Prager

<https://i2insights.org/2016/07/28/co-creation-or-participation/>



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Engage interest with different methods



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Methods of participation

- surveys, research
- cooperation through representatives
- pressure groups
- public meetings
- media engagement
- workshops and seminars
- walks and talks, street theater
- citizens science – observations, data gathering, reporting
- referendums, court hearings (worst scenario!)

Depends on case & goals

- who - actors
- How - methods
- when - phases

Good practice

- different actors
- mixture of methods
- in planning, construction and maintenance



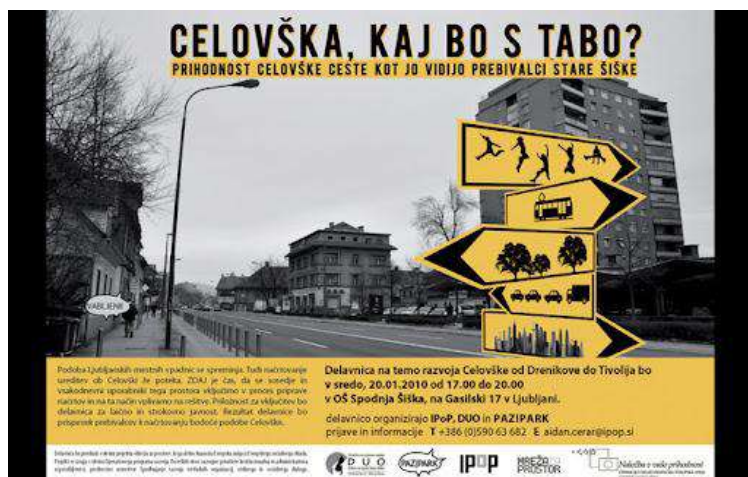
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Best practice - combination of methods



Diversity of actors & languages

- mayor's office and local politics
- civil servants
- public services
- public authorities & specialized agencies
- land & house owners
- residents
- regular & potential users
- local businesses
- civil society, NGO's
- design, biodiversity, water management, construction & other professionals

A diverse mixture of :

- groups
- interests
- roles & positions
- **languages!**
- powers
- responsibilities



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Tangible outcomes & building trust



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Image: Celovška kaj bo s tabo?
Pazipark Ljubljana, Slovenia

Good practice of participation

- honesty – intention to listen and respect
 - realistic expectations – not a miracle pill
 - equality of participants - consideration of special groups
 - transparency - publicity of professional activities and decision making
 - respect – trust – consideration
-
- carefully planned: time, people, money, space
 - publically announced and reported



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Diversifying methods and benchmarking



Letos smo v Kočevju imeli dve vrsti prometnih uradnih knjižek: tisto, ki smo jo že kar nekajkrat imeli, in tisto, ki smo jo prvič imeli. Zanimivo nas, kočevski, pa bo privedel do tega mesta v prihodnosti, kaj morebitne prometne trende in kaj se oblikuje drugje?

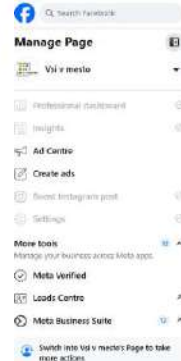
Pridružite se nam na javni razpravi o prometu v središču Kočevja, ki bo v ponedeljek, 20. septembra 2021, ob 17. uri v Kulturnem centru Kočevja.

Za udeležbo je skrajna prijava: septembra 17. v središču mesta.

1. središčni knjižki
2. središčni knjižki
3. središčni knjižki
4. središčni knjižki
5. središčni knjižki
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16. središčni knjižki
17. središčni knjižki
18. središčni knjižki
19. središčni knjižki
20. središčni knjižki



JAVNA RAZPRAVA
Sreda, 10. junij 2020
od 17h do 19h
Trdnica Kočevje



Success factors

- clarity, consistency, timelines
- accuracy of messages, information, data
- active listening: facial expressions, eye contact
- openness: accepting different opinions
- respect /empathy
- providing feedback
- two-way communication
- **from opposition to cooperation: yes... but**

- competence
- reliability
- comprehension check
- eliminating noise
- feedback



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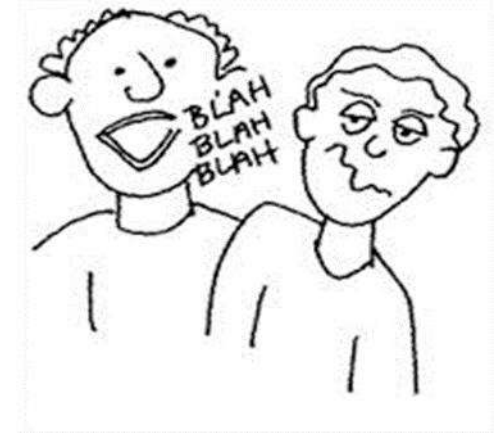
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Obstacles to success

- inability to define the content of the discussion
- rejection of different opinions – intolerance
- inability to change positions – low tolerance
- lack of understanding of roles
- lack of knowledge
- lack of resources, time, and space



- suspicion
- anger
- attacks
- ingrained habits
- prejudice
- intimidation
- displays of power



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Having fun & socialising



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Basics

- case based process plan: who, what - methods, when
 - defining working group: who will lead and execute
 - defining participation actors: who can and will participate
 - defining **case based** methods of participation
 - defining decision making process - be clear about it!
-
- defining interests – what is there for the involved actors – impact
 - provision of finances, people - mediators, time and space



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Participation & knowledge sharing

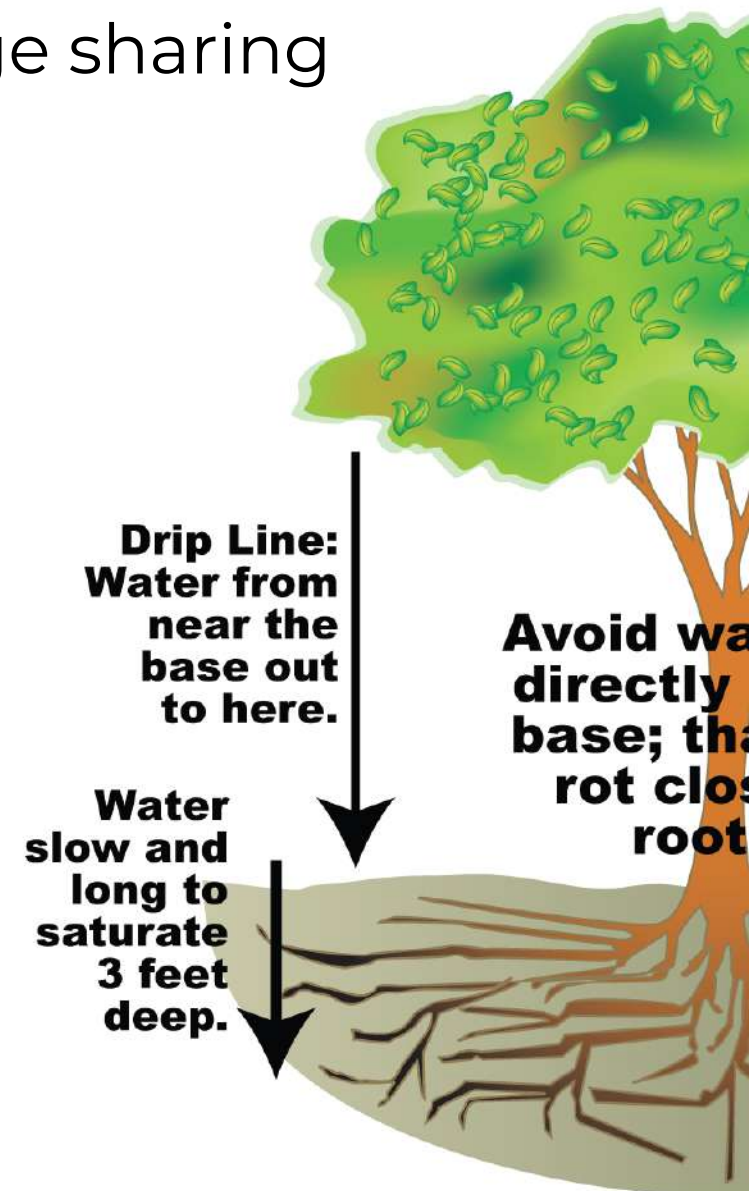
DELAVNICA RAVNANJA Z OKRASNO DR

KDO? certificirana arboristka TANJA GRMOVŠEK
KDAJ? četrtek, 06.04.2017, 11.00 - 16.00
KJE? Kozolec (TIC) jezero, Trdnjava 3
PRIJAVA 01 8938 251 ali tanja.stajdohar@kocevje.si

Delavnica sestoji iz teoretičnega in praktičnega dela. Na začetku bomo ponovili znanje novjših dejstev nege urbanih dreves. Poudarek bo na pravilnem sajenju dreves in optimalnem vzdrževanju mladih dreves prvih 25 let po sajenju. Predstavljene bodo osnove obžagovalne rezi glede na različno pričvrstitev vej in različne tehnike obrezovanja/obžagovanja glede na potrebe in cilje obrezovanja, starost dreves. Obravnavalo se bo tudi obrezovanje grmovnic.



OBCINA



3 pilot action themes

- heat mitigation
 - flood mitigation
 - enhancing biodiversity
-
- different focus – different structure of expert teams
 - different actor groups – case based selection
 - common and case-based information
 - case-based participation methods



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Public participation as an approach

- WHO WILL PARTICIPATE – DEPENDS ON GOALS
 - anybody, nearby residents, visitors, businesses, regular users, specific groups as youth, older, families
 - future everyday life, use and maintenance relevant actors
- PHASES - LEVELS - METHODS
 - preparation, planning, construction, maintenance
 - levels of participation
 - methods



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Project timeline – participation

JAN 26

APR 26

FEB 27

OCT 27

2.3 Building citizen's engagement

2.2 Developing the Urban nature plans

3 The demonstrations

4.2 New gen. of policy proposals

Project timeline – participation

- Activity 2.3 → **Building citizen's engagement**

period 2-4 (**1. 10. 25 – 31. 2. 27**)

- „partner cities create a step by step program for involving citizens in pilot activities“
- greenathon – heckaton-style events in each pilot city
- the project intention: long-term cooperation of public actors in urban greening with the citizens

Project timeline – participation

Activity 2.2 → **Developing the Urban nature plans**

period 3-5 (**1. 4. 26 – 1. 10. 27**)

- „...involving different departments and/or different municipalities in co-decision processes...”
- „developing mechanisms for local public participation to involve businesses and local public in implementing and managing urban green spaces.”

Project timeline – participation

Activity 3 → **The demonstrations**

period 3-4 (**1. 4. 26 – 31. 2. 27**)

- Open Green Park Day in each pilot city- providing key messages to people
- other ways of public participation according to step-by-step programme (2.3)

Project timeline – participation

Activity 4.2 → **Elaborate for a new generation of policy proposals to scale-up project results**

period 4-5 (**31. 2. 27 – 1. 10. 27**)

- Final interactive workshop in each pilot city – for the policymakers in the relevant policy fields



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Participatory process

stakeholder analysis workshop

Maja Simoneti and Urška Didovič, IPoP

Barcelona, 16. 2. 2026

Warm-up

 Mentimeter

Go to

www.menti.com

Enter the code

4478 9246



or use this QR code

Warm-up, results and discussion

Responses



Have you ever involved people in any way?



16 / 16

YES



NO



20%

40%

60%

80%

100%

Group work

- 3 groups – per pilot action theme:

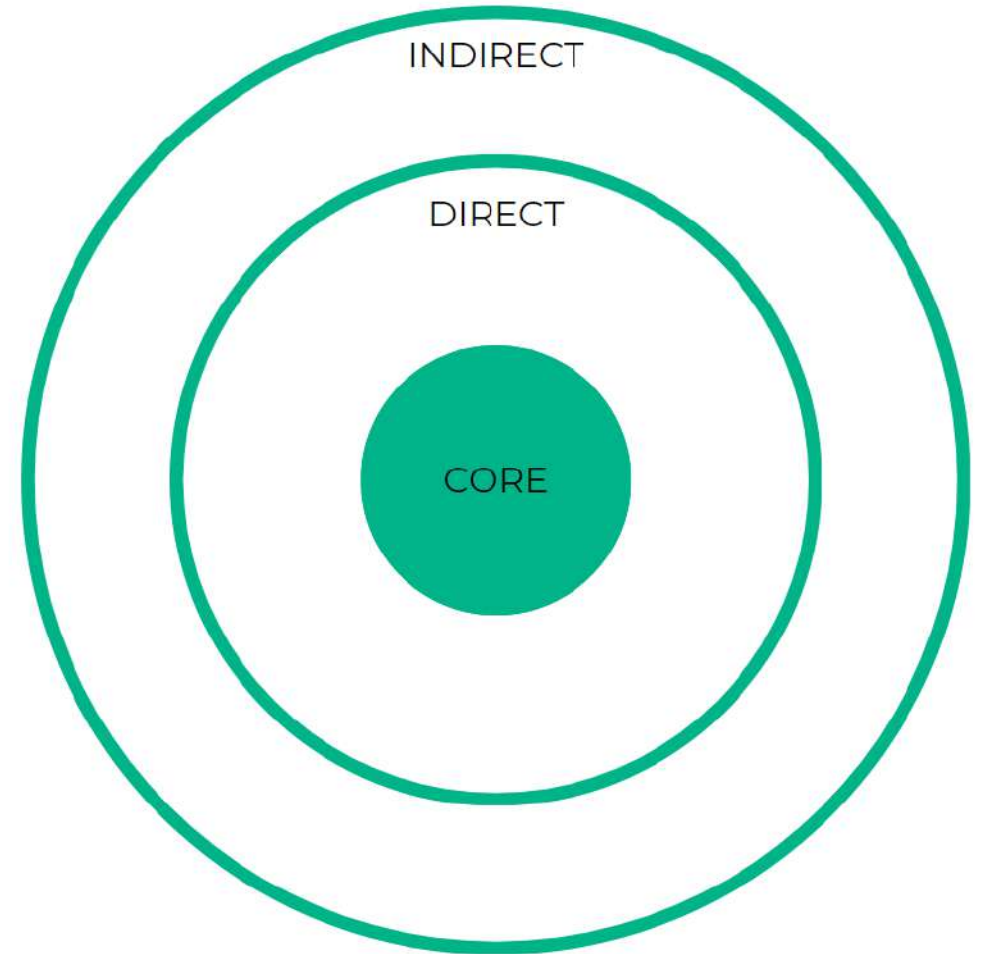
group 1	group 2	group 3
Heat mitigation	Urban flood mitigation	Enhancing biodiversity
Celje (SI)	Ioannina (EL)	Varaždin (HR)
Gjorče Petrov (MK)	Budva (ME)	Suzzara (IT)

Group work – Stakeholder analysis

- Time: 20 minutes
- **Which stakeholders are relevant to be included in your pilot action?**

<https://shorturl.at/ggTm0>

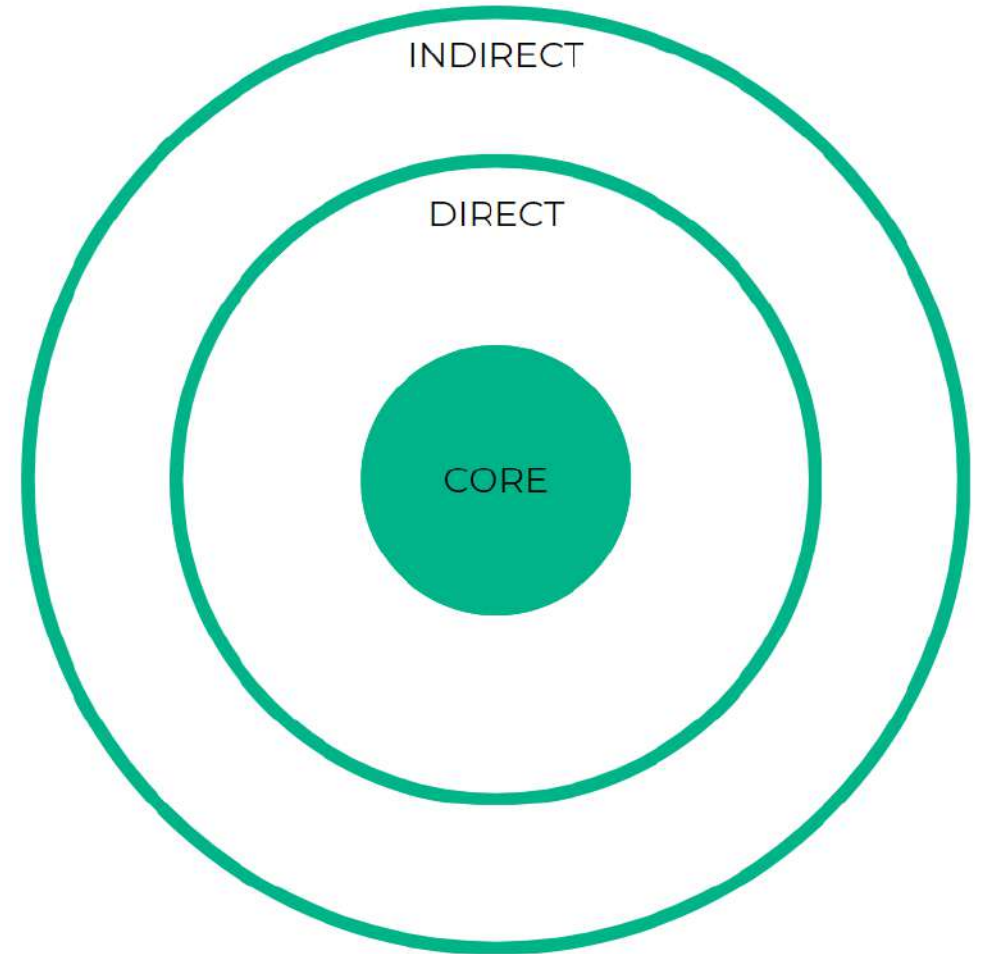
- 15 min discussion



Group work – Stakeholder analysis

List of potential stakeholders

- municipal administration (department for the environment, spatial planning, social activities)
- public services
- municipal councilors, district representatives
- local residents
- neighbours (and users) of the space
- representatives of local interest groups/NGOs on the topic of greening, biodiversity, nature conservation...
- influential individuals (local advocates, experts, professionals)
- visitors of the space
- business representatives
- tourism representatives





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Thank you!

dr. Maja Simoneti, Urška Didovič

IPoP

✉ maja.simoneti@ipop.si / urska.didovic@ipop.si

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Urban forests

Advancing Green Infrastructure in
Small and Medium Cities

Vinko Paulić and Iva Šikić-Vargašević,
UNIZG FFWT

Barcelona, 17.2.2026

INTRODUCTION

- In Europe, approximately 76% of people currently live in urban areas, and this share is expected to rise further→ nearly three out of five urban areas are set to expand by 2050.
- Growing urban populations increase pressure on land, leading to competition between built development and green spaces
- Urban expansion amplifies environmental challenges such making existing urban green areas more stressed and vulnerable.



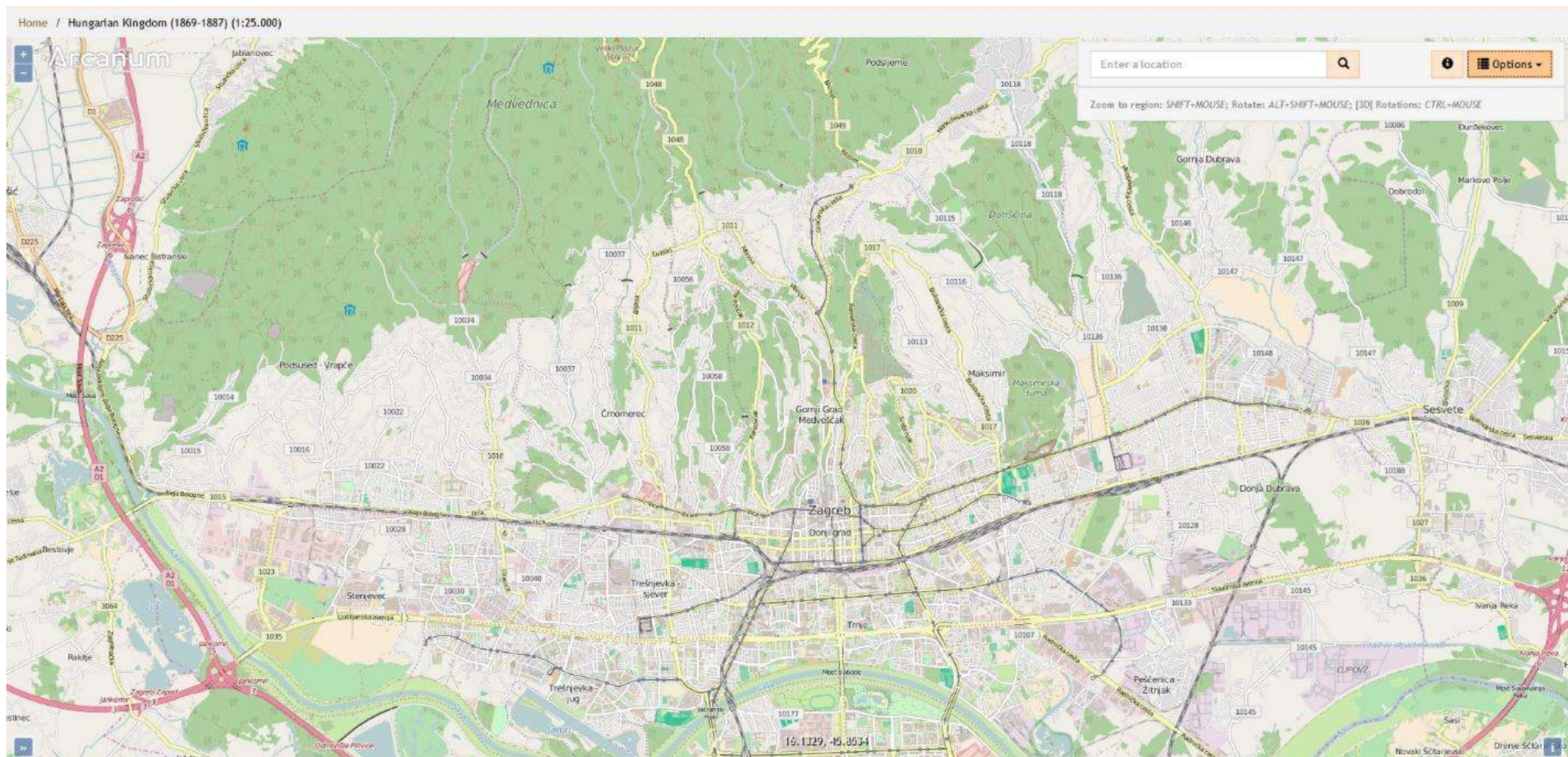
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INTRODUCTION



Example of urbanization in Zagreb (CRO)



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- Demand for greenspaces rises with urbanization, creating a mismatch between the need for recreational, health-supportive natural areas and the shrinking availability of such spaces as cities grow denser
- Climate change compounds these pressures, intensifying challenges that greenspaces face
- Green infrastructure provide critical ecosystem services, that become even more essential as population density increases.



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Total carbon [tC ha⁻¹]



Urban agriculture



Green walls

Urban green
infrastructure



Urban woodlands



Suburban street trees



City street trees



Green roofs



Sensitive urban design



Parks, gardens & golf courses

What is urban forest (UF)?

- Urban forests are networks of all woodlands, groups of trees, and individual trees located in urban and peri-urban areas, including forests, street trees, park trees, garden trees, and even trees in derelict spaces.
- They serve as the backbone of urban green infrastructure, connecting rural and urban areas and helping reduce cities' environmental footprint



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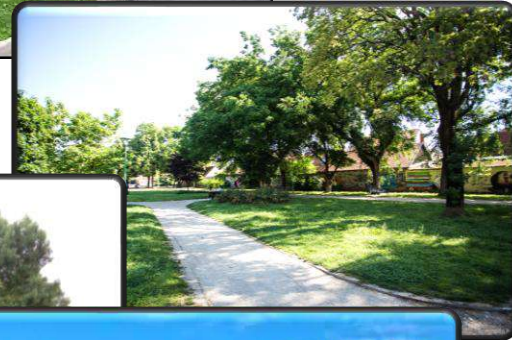
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Types of urban forests

- Peri-urban forests and woodlands
- City parks and urban forests (>0.5 ha).
- Pocket parks and gardens with trees (<0.5 ha).
- Trees on streets or in public squares
- Other green spaces with trees



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Ecosystem services provided by urban forests

Supporting

(biodiversity,
habitat provision,
soil formation,
water cycle)

Regulating

(Air purification,
carbon
sequestration,
climate regulation,
urban heat island
mitigation, flood
reduction)

Provisional

(Food, water, wood
and fiber, genetic
recourse)

Cultural

(Recreation,
aesthetics,
landscape,
wellbeing)

Ecosystem processes

Final ecosystem services & goods



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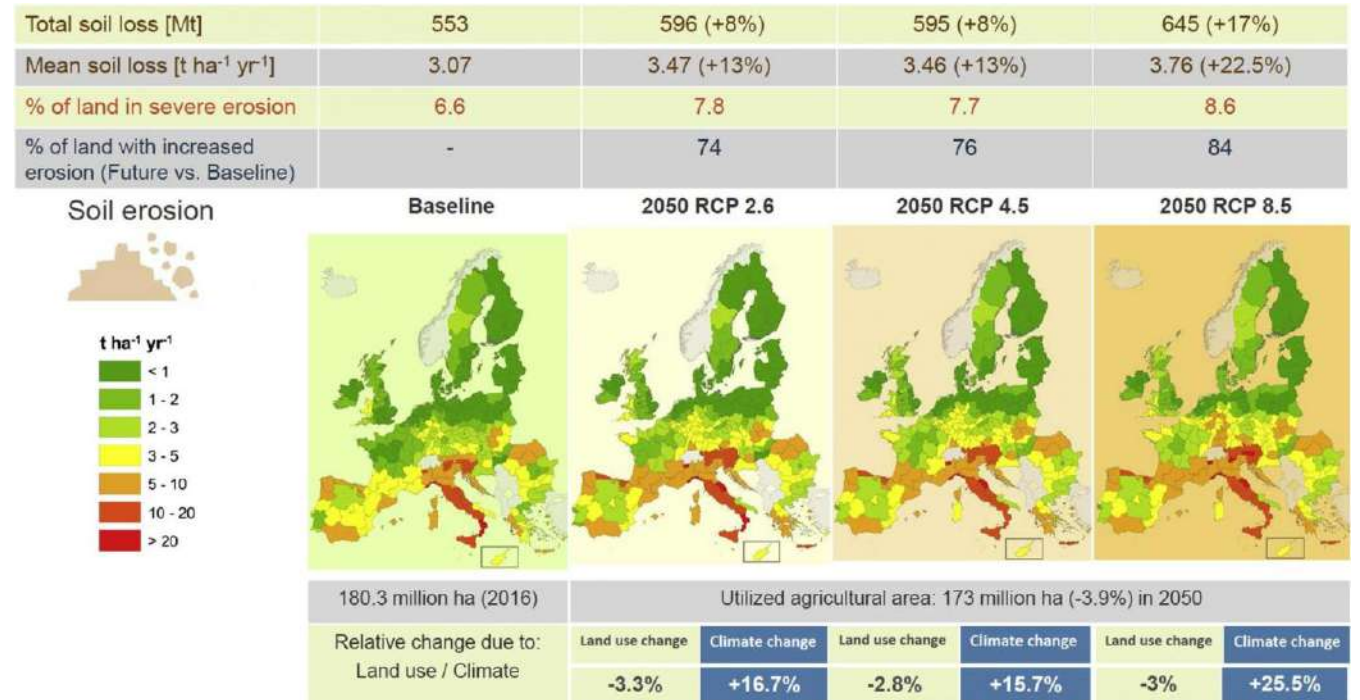
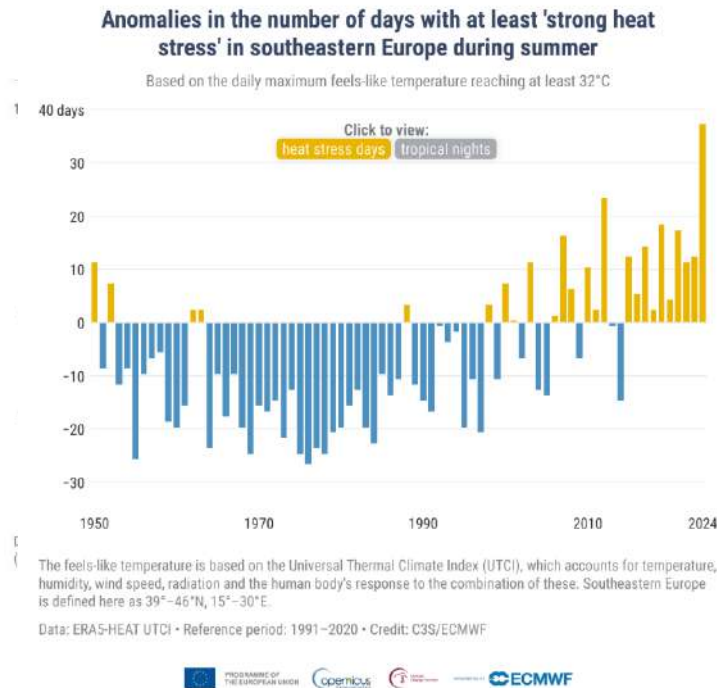
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ENVIRONMENTAL CHALLENGES FOR URBAN FORESTS

- Increased air temperatures and heat waves
- Heavy rainfall-amplified in intensely paved and sealed areas



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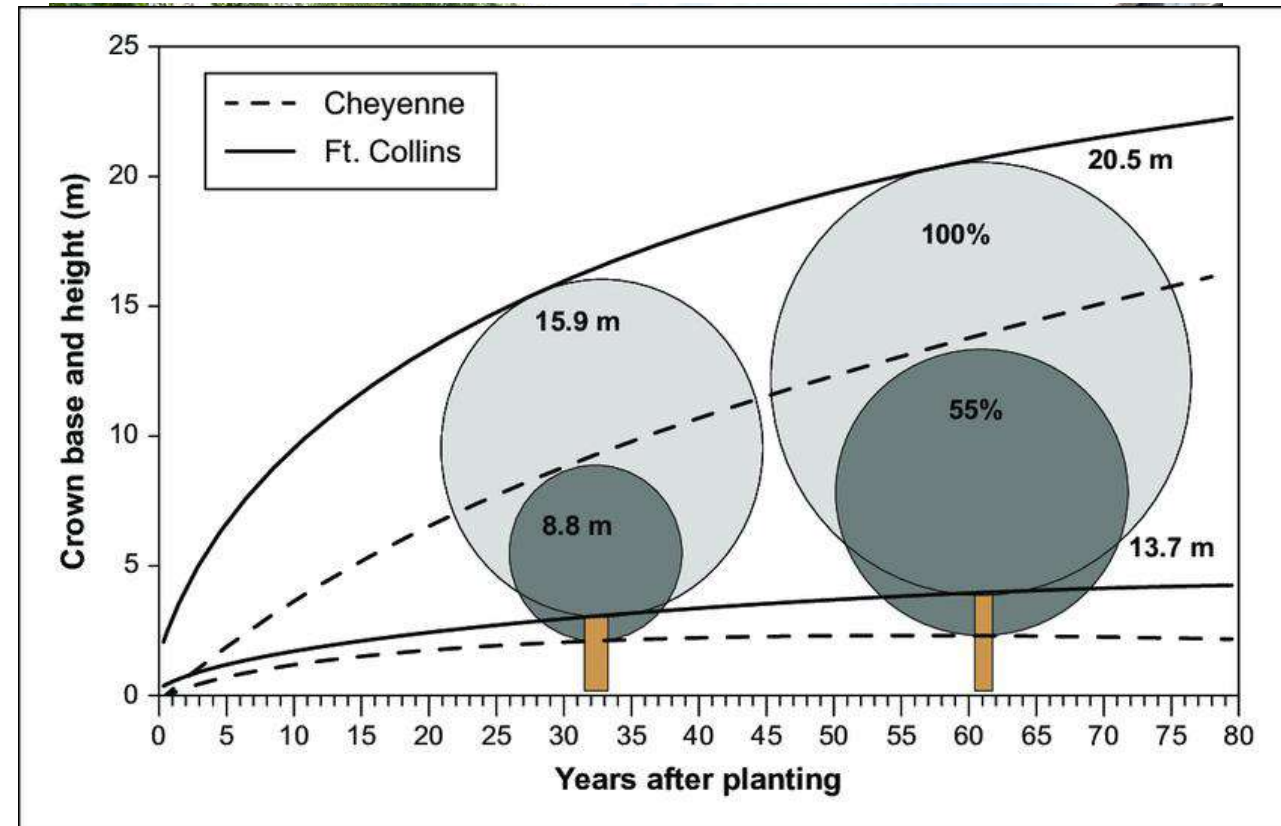
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ENVIRONMENTAL CHALLENGES FOR URBAN FORESTS

- Pollution (air, water, noise, light)



- Restricted space for tree growth



McPherson and Peper 2012



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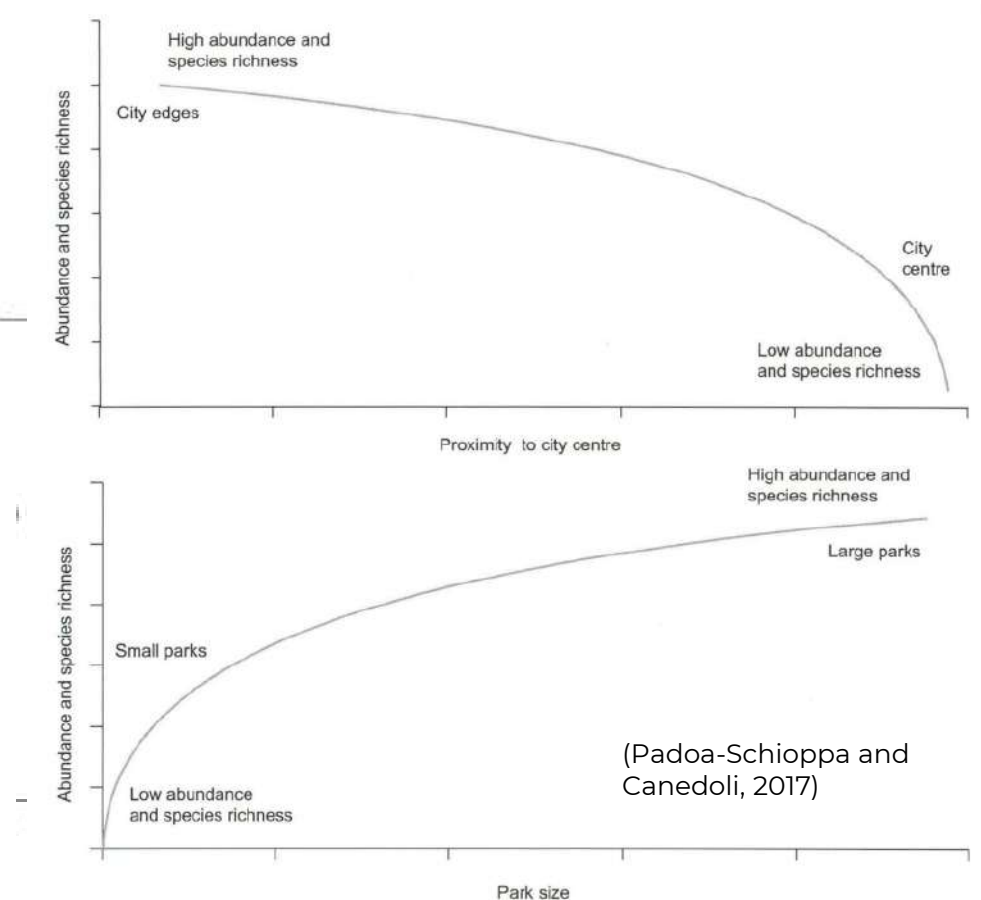


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ENVIRONMENTAL CHALLENGES FOR URBAN FORESTS

- Loss of biodiversity

- Invasive pests and diseases



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URBAN FORESTS AS NATURE BASED SOLUTIONS

Heat reduction through urban forests

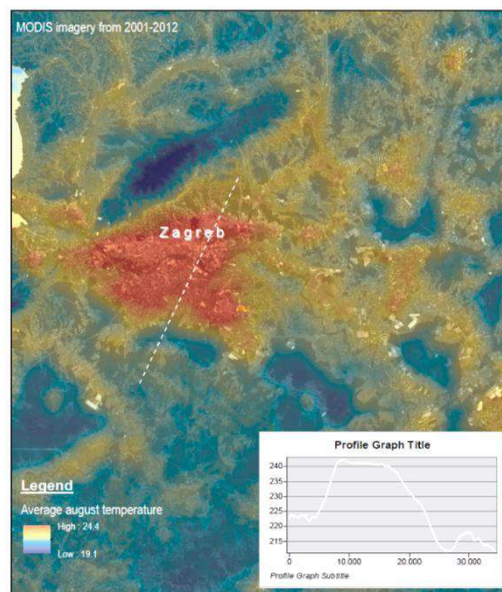
Olympics: Tokyo tests water sprinklers to keep streets cool at 2020 Games

KYODO NEWS - Aug 13, 2018 - 14:46 | All, Japan, Sports, Olympics



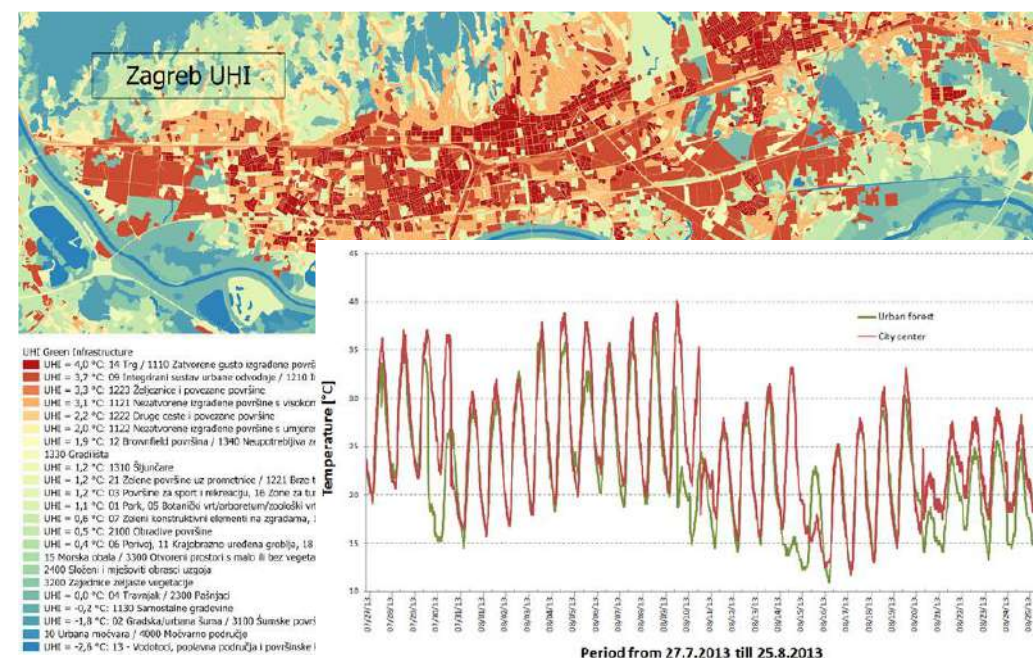
Ger
Zaf

Mapping of UHI



UHI Zagreb (CRO)

- Reduction of UHI with different types of UGI



UHI Zagreb (CRO):
-2,6°C for water bodies
-1,8°C in urban forests

Ljubljana (SLO): -2,7°C
reduction in urban forests
during heat wave (Vilhar et al., 2015)



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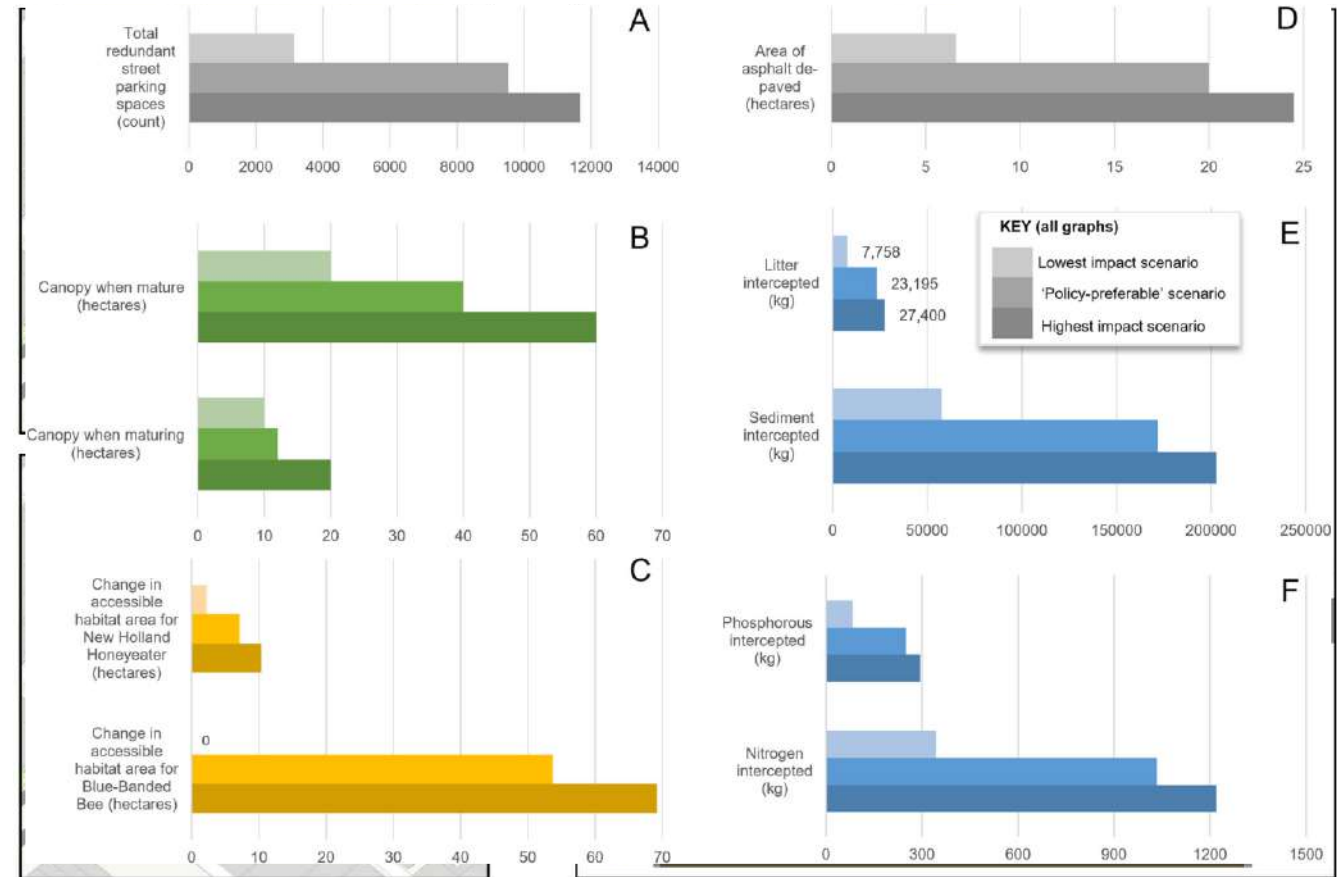
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Depaving as NBS

- Exposing more of the ground in urban spaces



- Removal of parking spaces in with NBS



Croeser et. al. 2022



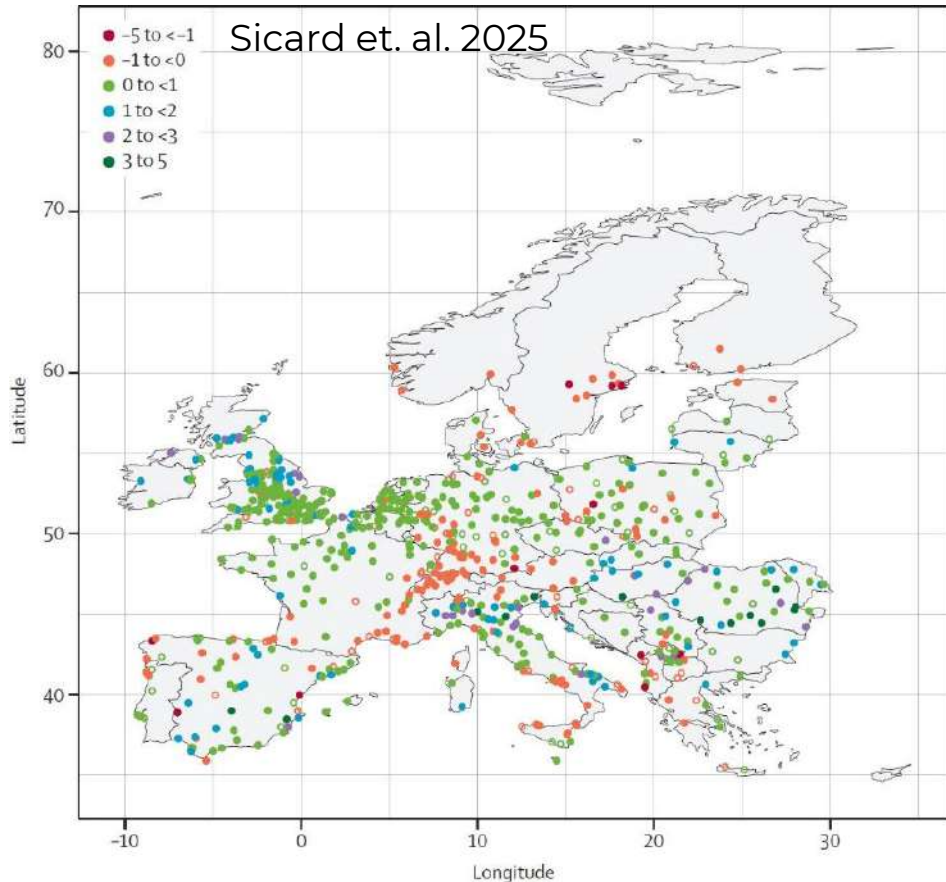
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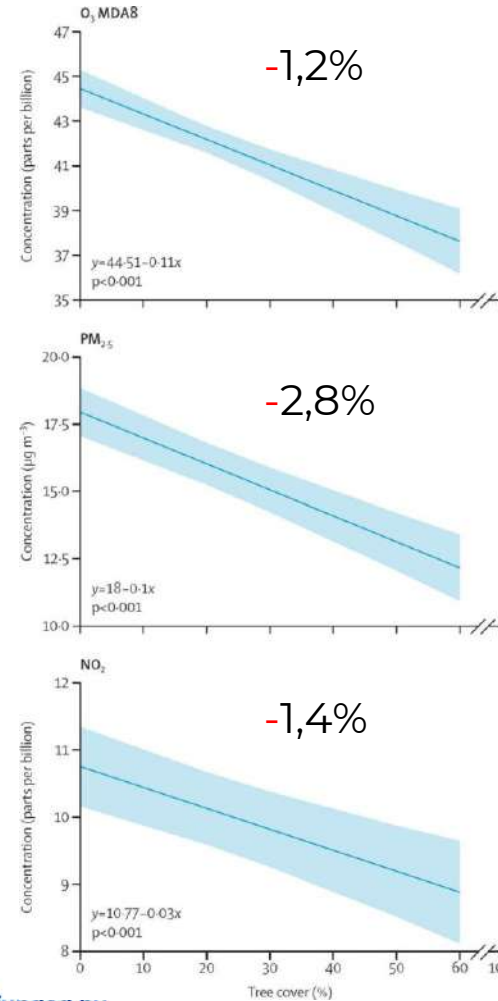
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Air pollution improvement

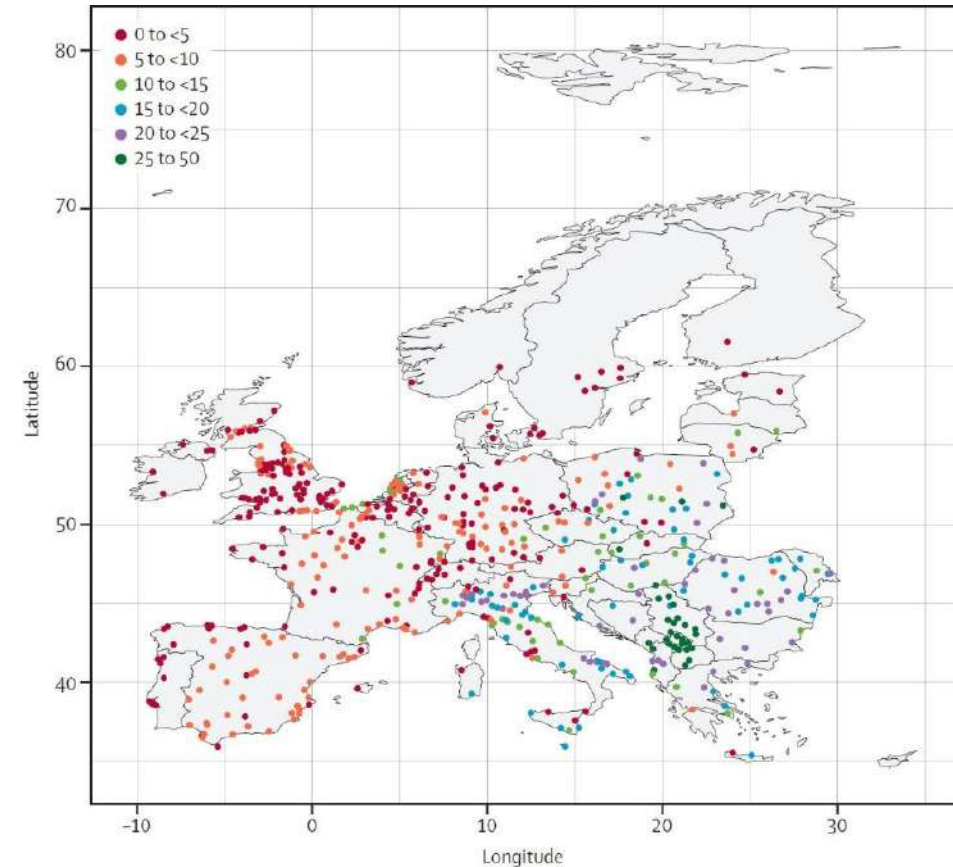
- 25% of population in areas with a mean tree canopy coverage >30%.



+ 5% tree canopy=



- N of a prevented deaths by increasing current tree coverage to >30%.



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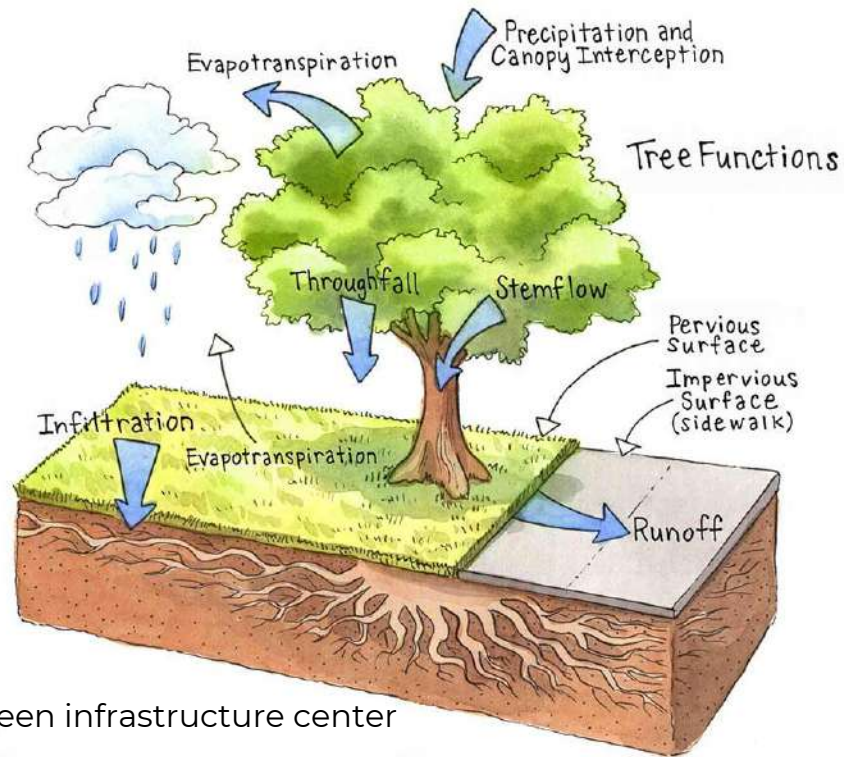
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Stormwater reduction

- Urban trees reduce stormwater through canopy interception, evapotranspiration, infiltration improvement, runoff reduction

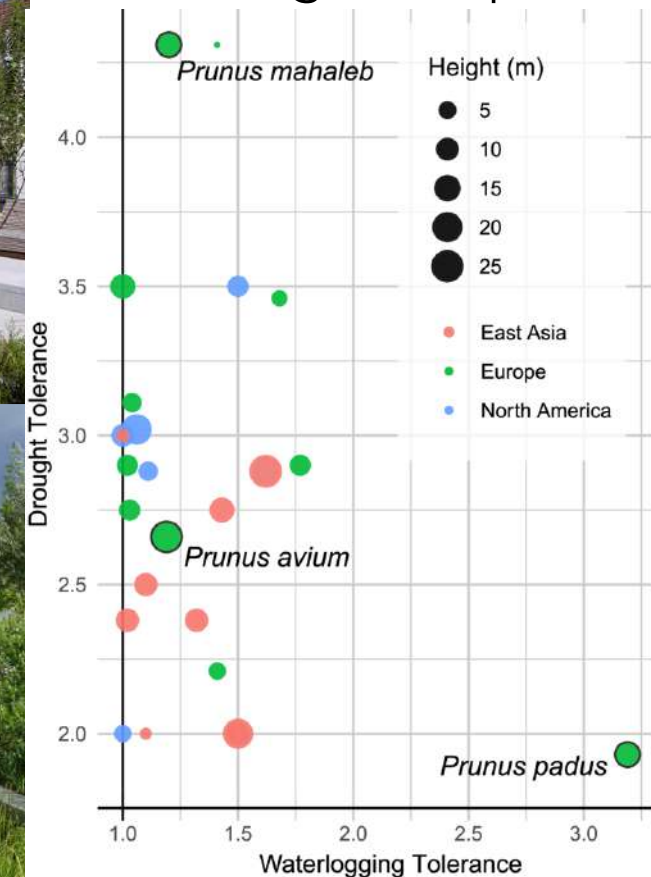


©Green infrastructure center

- used as part of Sustainable Urban Drainage Systems (SUDS) for temporarily storing water in systems



- waterlogging and drought tolerance of same genus species



Wiström et al. 2023



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Carbon storage and sequestration



Elon Musk 
@elonmusk

Am donating \$100M towards a prize for best carbon capture technology

4:08 PM · Jan 21, 2021

51.3K Retweets

18.6K Quote Tweets

556.4K Likes



Elon Musk 
@elonmusk · Jan 21, 2021

Replying to @elonmusk

Details next week

5,334

3,063

88.4K



Ross Gerber 
@GerberKawasaki · Jan 21, 2021

Replying to @elonmusk

A tree?

438

396

19.8K



Elon Musk 
@elonmusk · Jan 22, 2021

Replying to @GerberKawasaki

They are part of the solution, but require lots of fresh water & land. We may need something that's ultra-large- scale industrial in 10 to 20 years. For now, by far the top priority is accelerating the transition to a sustainable energy economy.

1,354

1,155

15.4K



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Sessile Oak €21
VAT incl.

Uneven-aged high forest

Thisted Forest

Time before cutting: 135 years

Benefits

Estimated CO₂ absorption: 900 kg

Expected gross gain : €304

- 1 +

Add to cart →



Maple €22
VAT incl.

Uneven-aged high forest

Thisted Forest

Time before cutting: 70 years

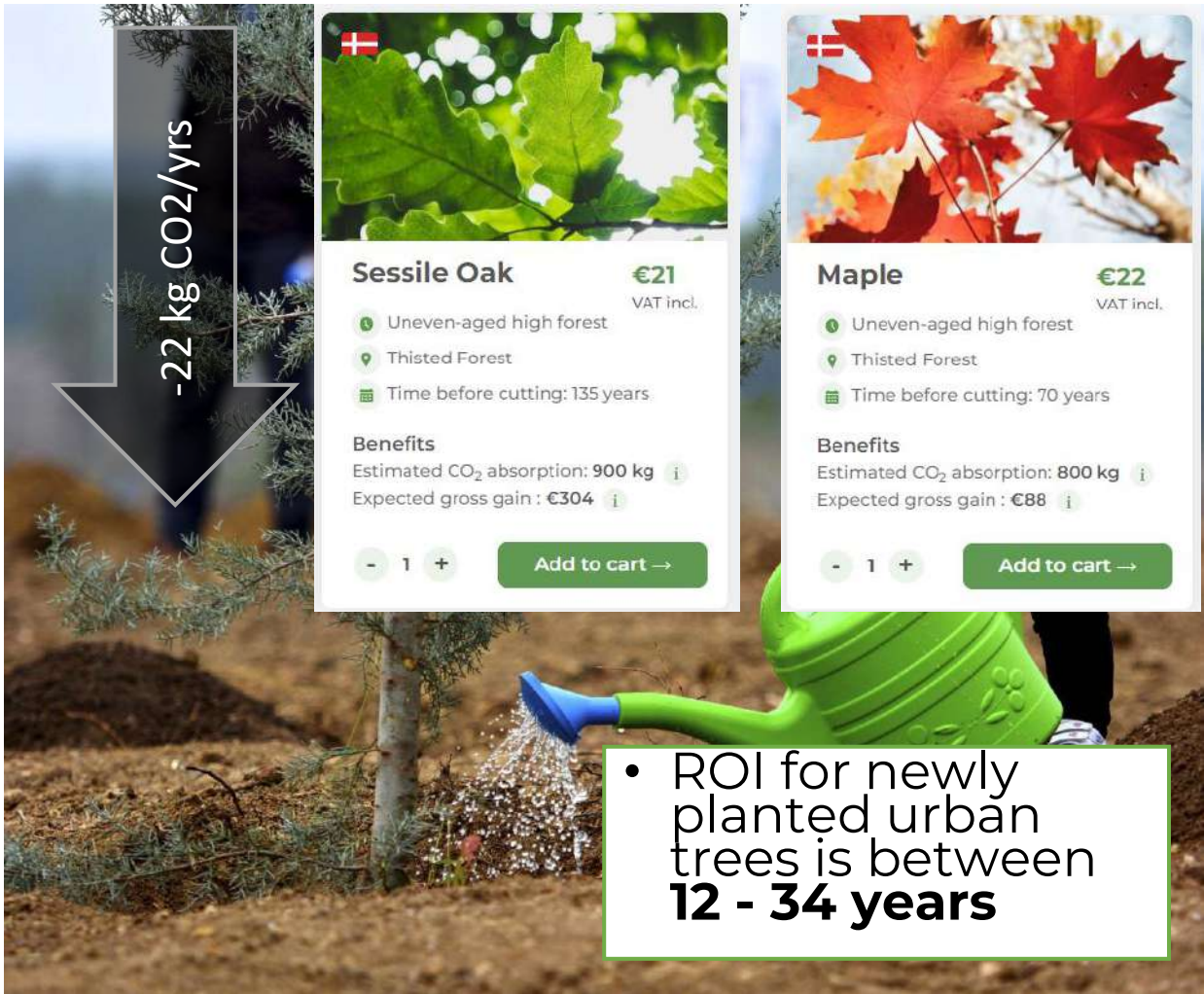
Benefits

Estimated CO₂ absorption: 800 kg

Expected gross gain : €88

- 1 +

Add to cart →



-22 kg CO₂/yrs

• ROI for newly planted urban trees is between **12 - 34 years**

KEY PERFORMANCE INDICATORS FOR URBAN FORESTS

Number of trees

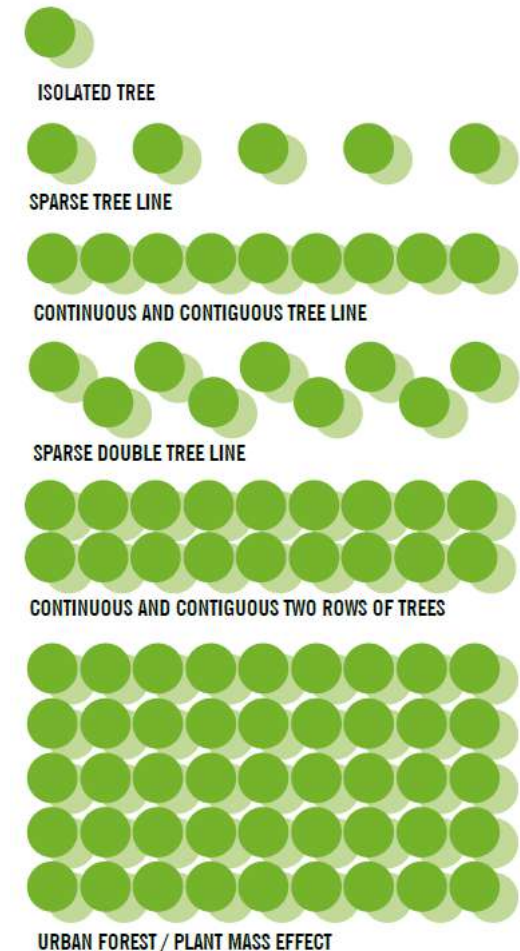
- Planting initiatives: The EU's Green Deal promotes large-scale, biodiversity-friendly tree-planting—aiming for 3 billion new trees by 2030



- Key principles:
- additional trees
- do no harm principle
- native trees and climate adapted species
- mapping
- pledge



- Newly planted trees need decades to deliver ES-'bigger is better'



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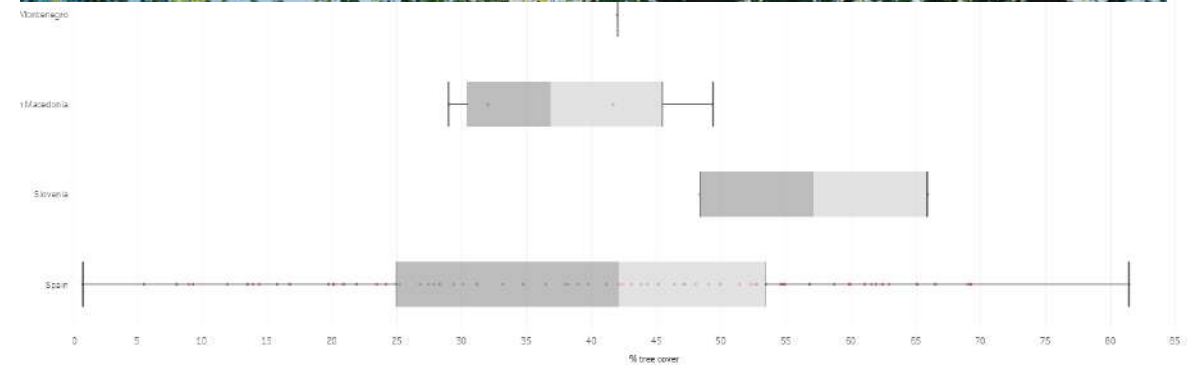
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Canopy cover

- The tree canopy cover — i.e. the proportion of the urban area that is covered by the tree canopy → goal of 30% canopy cover
- It can be measured using various sampling and mapping methods



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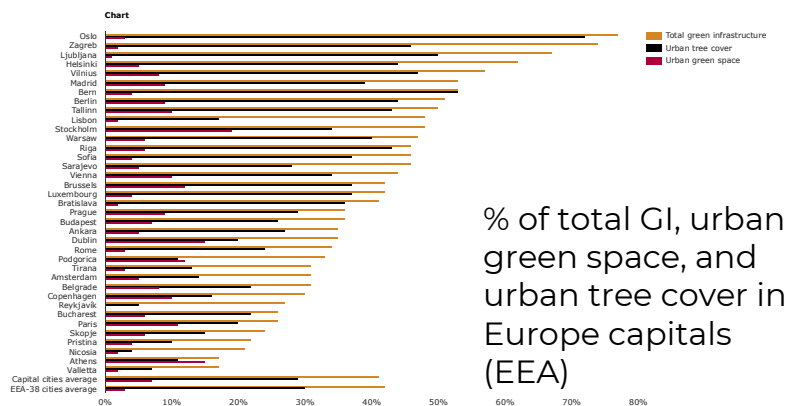
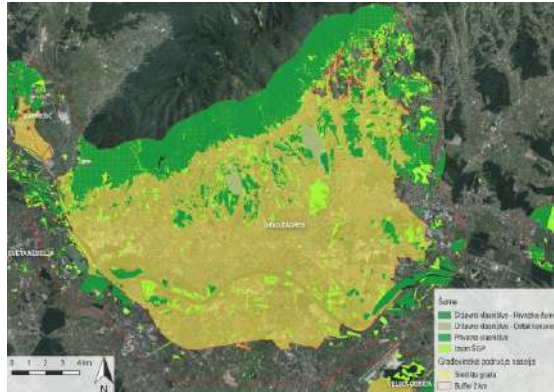
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Green areas & accessibility

- Green space supply: 4-7 (9) m² p.p.
- Green areas accessibility: within walking distance (300-500 m)
- Green space connectivity: 500 m maximum distance between two green spaces



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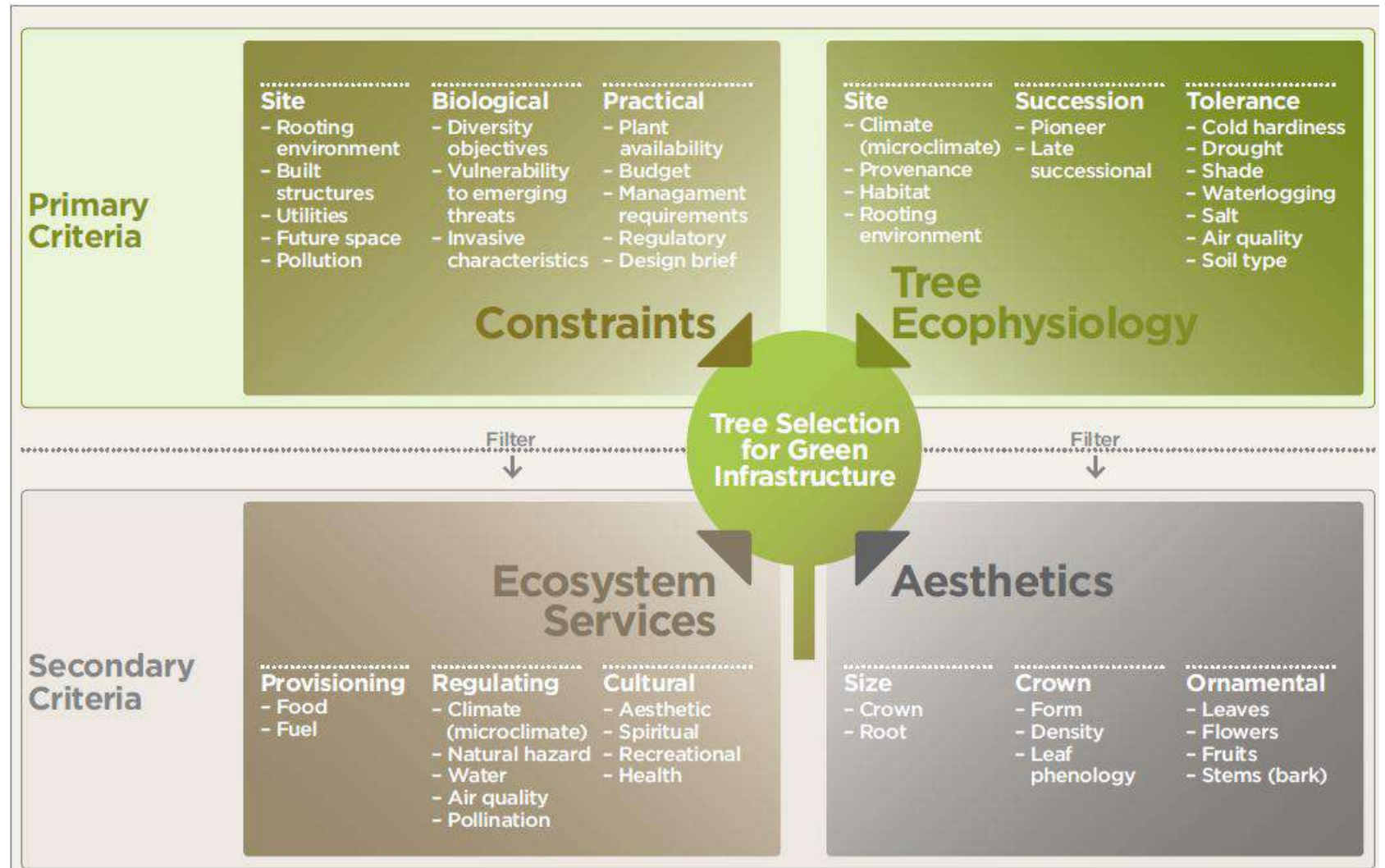


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FUTURE CONSIDERATIONS FOR IMPROVEMENT OF URBAN FORESTS

Urban tree species selection

- Effective tree selection relies on 4 factors which are divided into two priority criteria's



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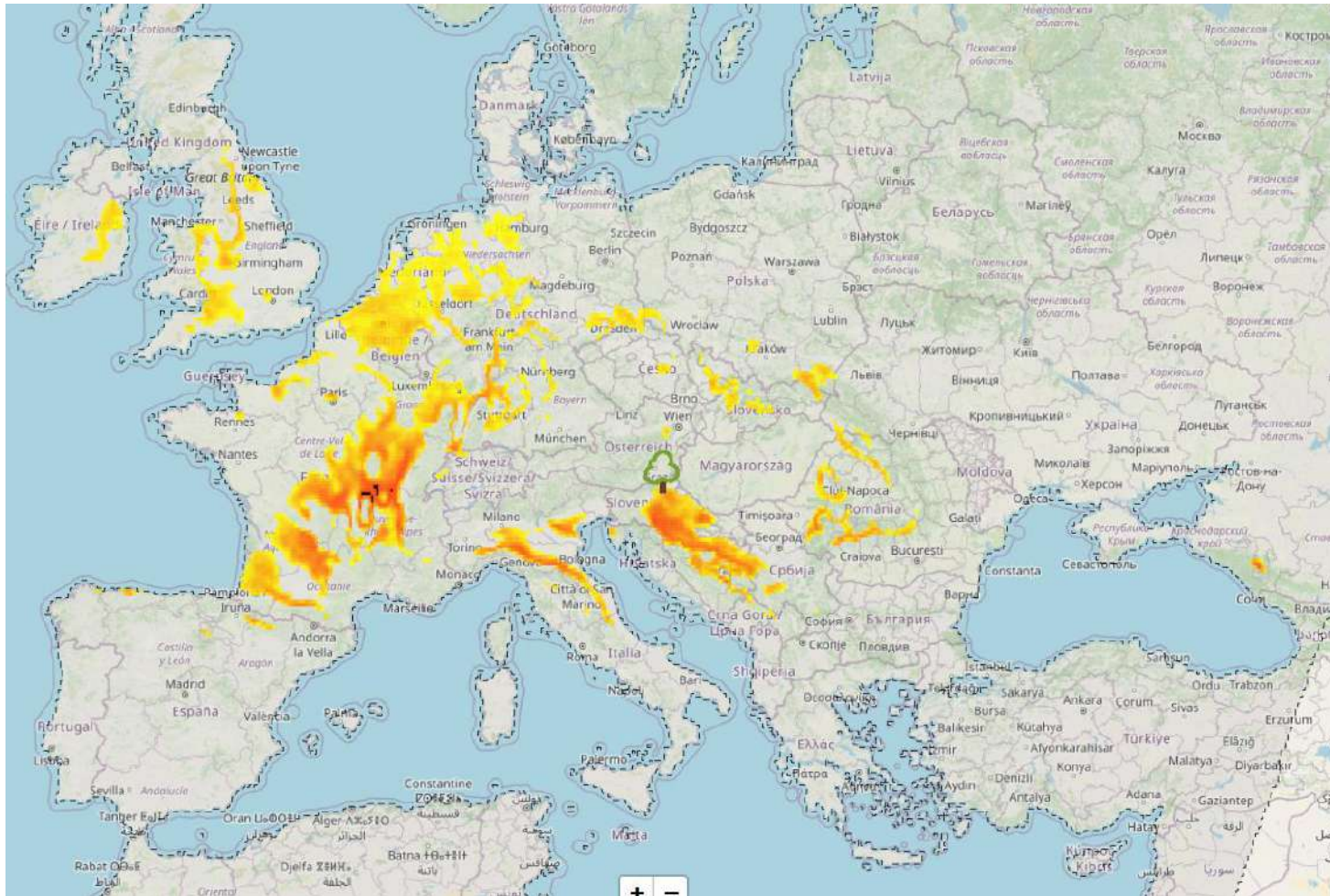
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(Hirons and Sjöman, 2018)

Matching tree species selection with future climate



- **Example: Celje (SLO)**

- Areas that currently (1991-2020) have a similar climate to that expected in 2031-2060 at the selected location



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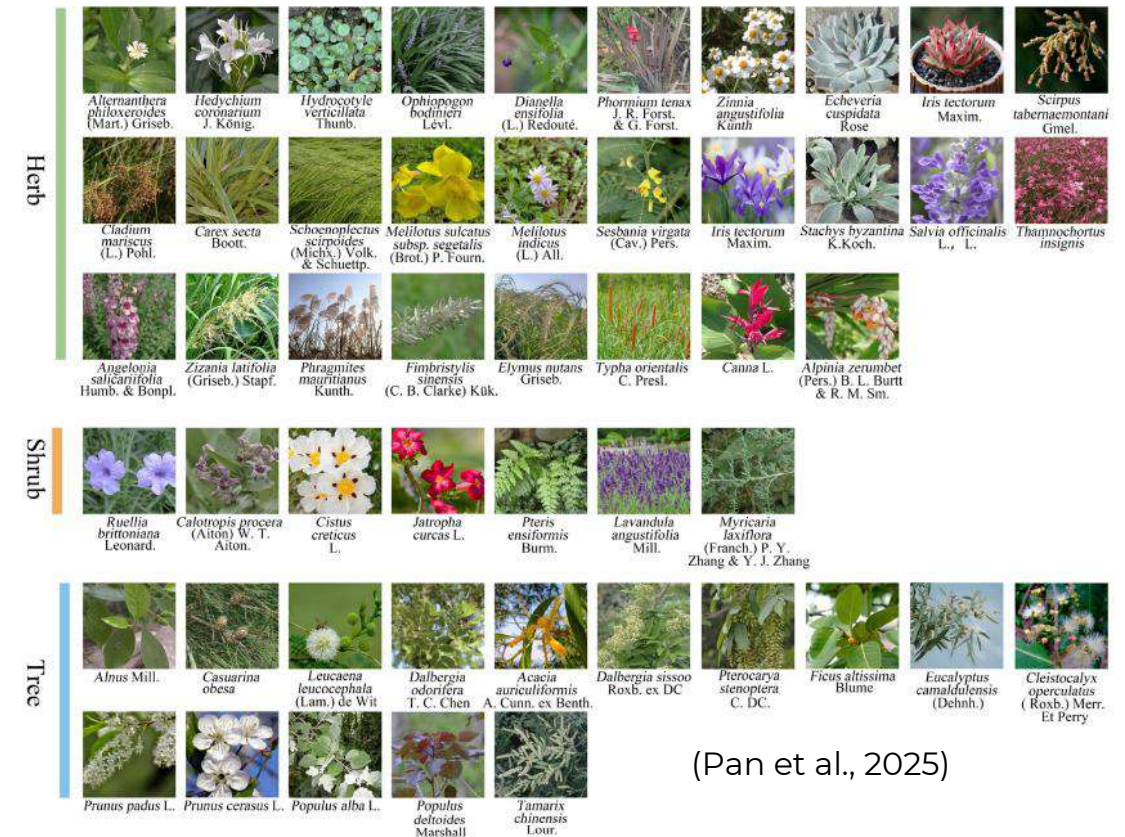
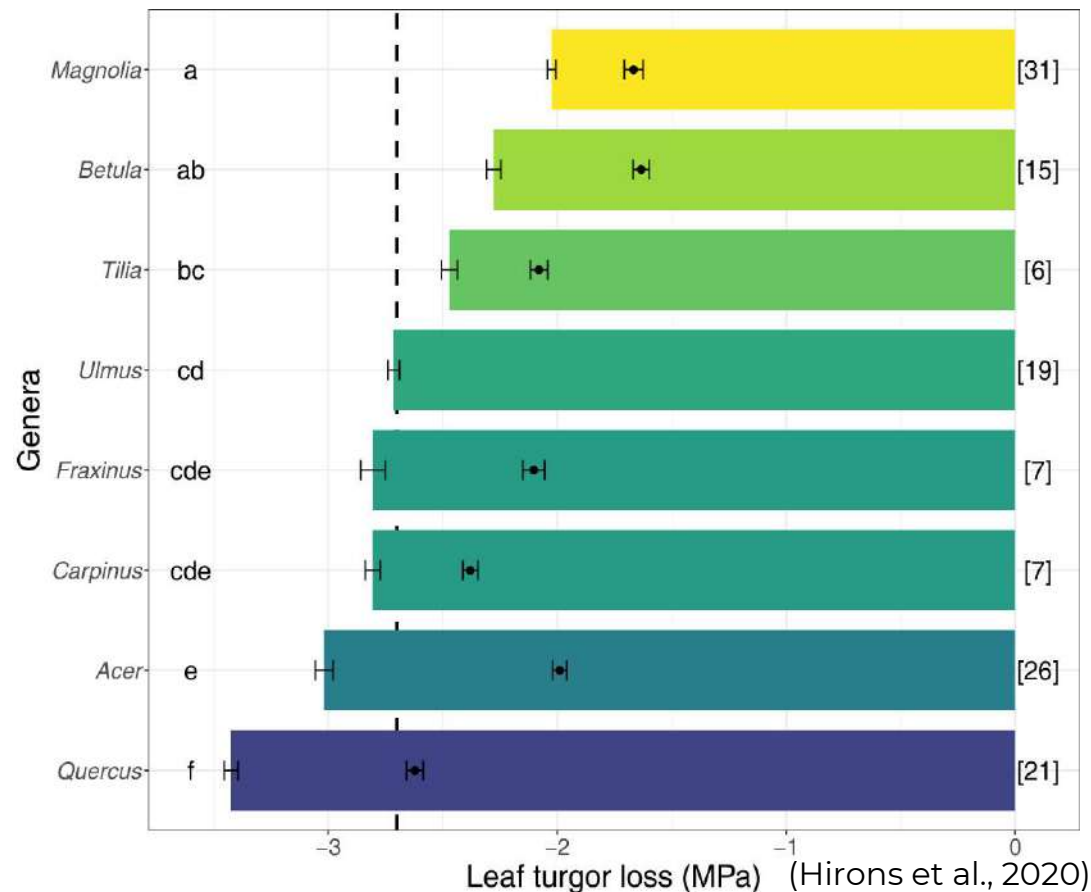


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climatematch.org

Use of resilient tree species

- Identify species for the future which are resilient to drought stress or waterlogging



(Pan et al., 2025)



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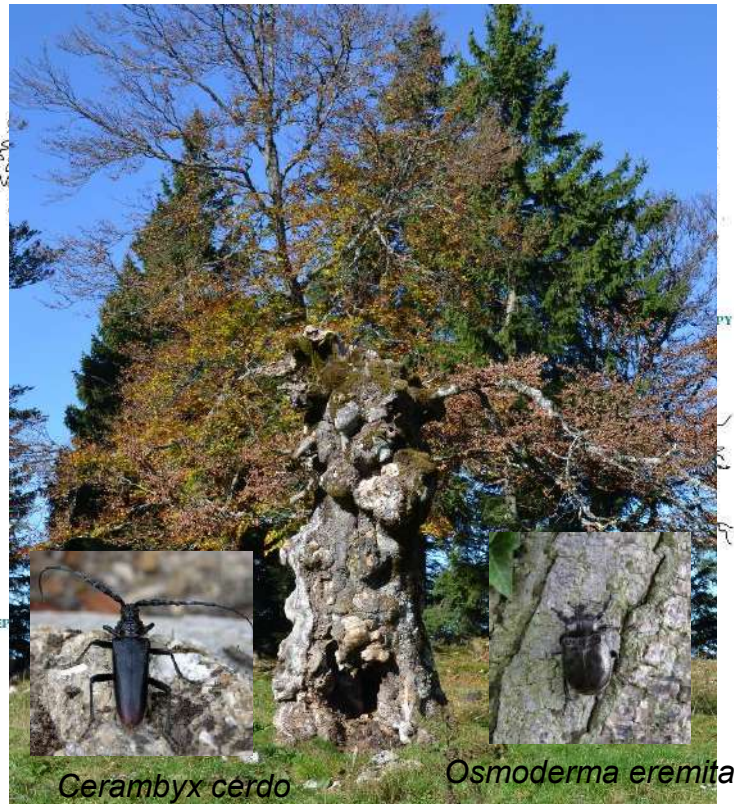


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Biodiversity in urban forests

- Critical component of ecosystem health and resilience of urban forests
- Lack of certain habitats in relation to types of UF → promote conservation actions through different measures to preserve/create specific habitats

- Conservation of dead trees

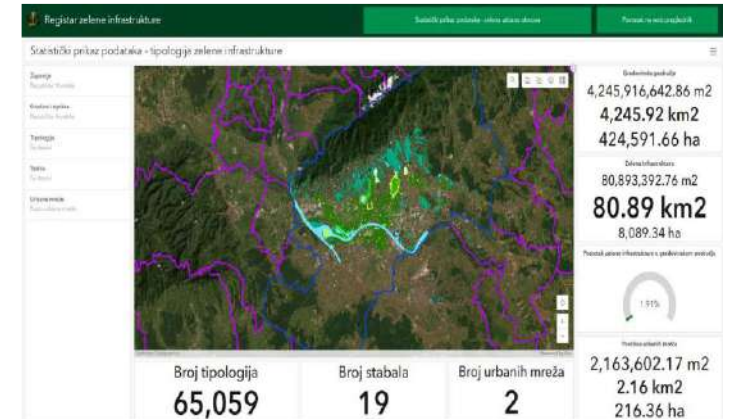
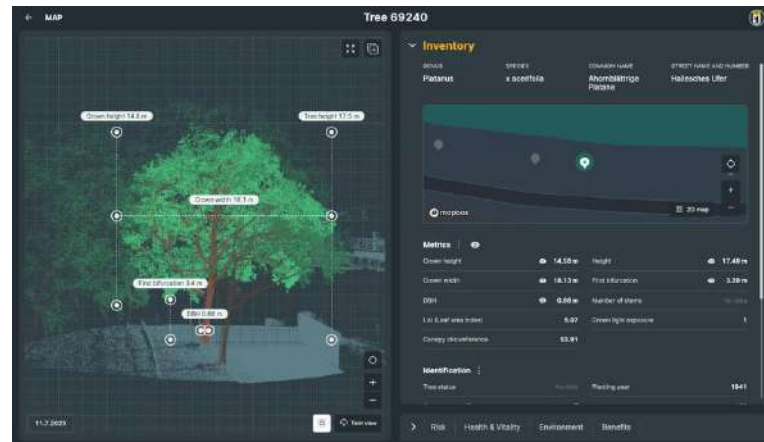
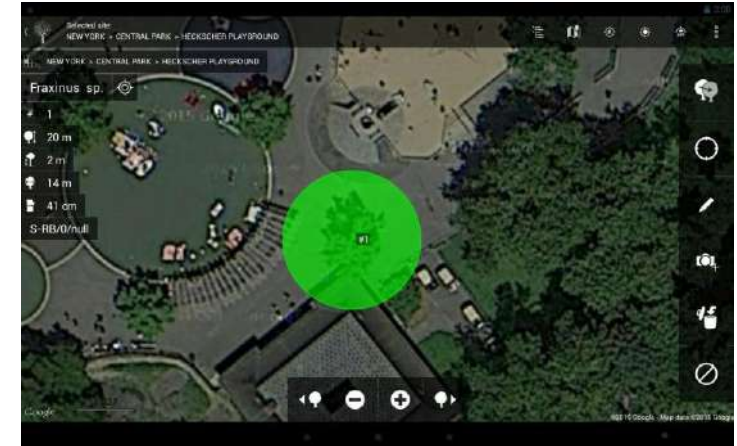


- Formation of habitat trees



Tree inventory

- Important management tool for planning, prioritizing and monitoring of urban forest resources



TAKE AWAY MESSAGE

- Urban forests occur in diverse forms and deliver a broad spectrum of ecosystem services.
- They function as effective nature-based solutions for major urban environmental challenges.
- Key performance indicators enable a quantifiable assessment of urban forest structure, extent, and service provision.
- Future practice should prioritize climate-adaptive planning, safeguarding critical urban-forest components, and advancing integrated management approaches.





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Thank you!

Vinko Paulić, UNIZG FFWT

Department of ecology and silviculture

✉ vpaulic@sumfak.unizg.hr

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UrbanGreenLeap training

Building impact through data: from baseline collection to planning and pilot design

Iliriana Sejdullahu, Ambiente Italia srl.

Barcelona, 17.02.2026

WP2 Training objectives



Understand the importance of baseline data for evidence-based Urban Nature Planning aligned with EU frameworks.



Learn what data is needed and how to use it to design Urban Nature Plans and pilot actions in participating cities.



Demonstrate a practical example of NbS mapping to show how spatial data supports decision-making, planning, and pilot design.



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Design parameters in UGL, not blockers

The training assumes:

- no guaranteed GIS expertise across all participants
- uneven access to local high-resolution layers (trees, land use, drainage),
- mixed legal/data regimes (EU and non-EU partners; differing local data access norms)
- limited staff time for ongoing monitoring,
- variable device/connectivity constraints for field data collection
- no fixed software budget (hence parallel open-source/proprietary options)



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Framing and why 'data' impact



Without data:

- decisions are based on assumptions
- priorities may be wrong
- investments may fail

With data:

- decisions are evidence-based
- impact is measurable
- funding is easier to justify

© Future Cities Laboratory, ETH Zurich
Singapore Views | CIVIL, editing: Kateryna Konieva



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Framing and why 'data' impact

- Data is not just collection.
- It supports the entire Urban Nature Plan.

Baseline Data → Analysis → Planning → Pilot → Impact → Monitoring

- **Baseline data** = description of the current situation of your city.

It answers:

- What do we have?
- Where are the problems?
- Where are the opportunities?



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Framing and why 'data' impact

A robust baseline usually mixes four channels:

- 1. Remote sensing + GIS inventory (core layer)**- Sentinel-class products can support land surface monitoring and vegetation proxies (e.g., NDVI), and common remote sensing practice uses vegetation indices for urban greenness assessment. [\[Copernicus Sentinel-2\]](#)
 - Land surface temperature (LST) computed from satellite data is widely used for urban heat island assessments; studies note common use of Landsat and Sentinel imagery for LST in urban settings. [\[Garcia, 2021\]](#)
 - For standardized, policy-relevant layers at EU scale, Copernicus Land Monitoring products (e.g., imperviousness and tree cover density) are designed for understanding sealing/urban sprawl and tree cover, respectively. [\[Land Copernicus\]](#)
- 2. Field surveys** -Field surveys are the direct collection of data on-site to assess the presence, condition, and characteristics of urban nature. Tree inventory and plot sampling protocols can quantify urban forest structure and ecosystem services. [\[i-Tree Tool\]](#)



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Framing and why 'data' impact

A robust baseline usually mixes four channels:

3. Citizen science - Citizen science should follow good practice principles (participant value, data quality attention, open results where possible); the European Citizen Science Association sets out Ten Principles used widely as a best-practice reference. [\[www.ecsa.ngo\]](http://www.ecsa.ngo)

- Platforms like iNaturalist are designed to share biodiversity observations with scientific repositories and have strong uptake in biodiversity research. [\[www.inaturalist.org\]](http://www.inaturalist.org)

4. Administrative and operational data - Municipal land-use plans, parks maintenance logs, tree risk registers, irrigation records, complaints, and redevelopment permits often provide the most “implementation-relevant” baseline, even when not research-grade.

The Urban Nature Plan guidance framing emphasizes integrating nature planning into broader municipal planning practice rather than treating it as a standalone environmental document.



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Data quality, ethics, and interoperability

- **Data quality** should be treated as fitness-for-use: a dataset is “good” if it supports the decisions it will inform and its limitations are documented. The Commission’s better regulation guidance highlights the need for reliable evidence and real understanding of causality and intervention logic. [\[EC, 2023\]](#)
- **Ethics and privacy:** When data can identify individuals (e.g., geotagged complaints, participation registries, detailed movement/use tracking), projects must follow GDPR principles (lawfulness, purpose limitation, data minimization, accuracy). [\[Regulation \(EU\) 2016/679\]](#). For citizen science and engagement datasets, “collect only what you need to decide and evaluate” should be the default, with transparency about use.



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Data quality, ethics, and interoperability

- **Interoperability** is essential when partners and departments must share data. INSPIRE is the EU's legislative backbone for spatial data infrastructure and covers numerous spatial data themes and implementing rules.

[\[INSPIRE Directive, 2007\]](#)

In practice, interoperability often means: consistent coordinate reference systems, well-described metadata, and use of standard web services.

The Open Geospatial Consortium defines service standards such as WMS (map images) and WFS (feature access). [\[OGC.org\]](#) Many national/regional geoportals explicitly provide WMS/WFS services, reinforcing that partners can often connect to authoritative layers without duplicating datasets. [\[Lombardy Region, geoportale\]](#)



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UNP and data functions

The “role of data” is anchored into three functions:

- **Diagnose:** What is the current state and where are the hotspots/opportunities? (baseline analysis step)
- **Prioritize:** Where should limited resources go first, and why is that fair and defensible?
- **Prove & improve:** Did it work, for whom, and what do we scale? (monitoring, reporting, evaluation step)



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Urban Nature Plans

Urban Nature Plans are framed by the Commission and partner networks as:

- a **long-term integrated framework** (not a stand-alone, one-off document),
- produced through **cross-departmental coordination** and **participatory co-creation**, and
- grounded in **baseline analysis** and **indicators/targets**, with explicit **monitoring/reporting/evaluation**.



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Urban Nature Plans



5. Current state of nature and biodiversity: Assessing and documenting the existing state of nature and biodiversity in the urban area.

6. Indicators and targets: Identify specific metrics to measure progress and set target outcomes to achieve the Plan's objectives.

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Nature Platform



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UNP Step 5

Exploring the process - **Step 5: Current state of nature and biodiversity**

This step is about understanding the current state before it is possible to plan for the future. Analysing the current state of nature and biodiversity in urban areas involves **mapping land use types, assessing existing nature spaces** and **understanding socio-economic factors**. This data will help identify challenges, gaps and opportunities to improve urban ecosystems. This step also fulfils **Milestone 3:**

Current State Analysis, ensuring that the plan is based on sound data and evidence.

Key actions:

- ✓ Map public and private natural areas, including parks, gardens and tree canopy cover.
- ✓ Assess biodiversity and key habitats in urban areas.
- ✓ Identify challenges such as accessibility to natural spaces or risks such as pollution and climate change



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Step 5 – Key components

5.1. Maps of land-use types in the municipality, starting from the basis of the official 'Corine land cover' classification system.

The mapping should at least include:

- Overall public and private green space / Nature-based Solutions / Green Infrastructure
- Urban fabric
- Industrial/commercial/ transport areas including brownfield sites
- Agricultural land, including agro-forestry, pastures and natural grasslands



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Step 5 – Key components

5.2. Status and mapping of species in the municipality – including key/selected bird and pollinator species, such as butterflies.

5.3. Inventory of relevant **existing policies, strategies and plans** at local, regional, and national levels.

5.4. Additional mapping/understanding that will ensure a higher quality of urban nature planning include:

- Socio-economic factors: age, health and income
- Flood risk
- Heat mapping
- Noise mapping
- Air pollution
- Accessibility/ availability of green spaces



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UNP Step 6

Exploring the process - **Step 6: Indicators and targets**

Setting indicators and targets is key to tracking progress and ensuring success. This step involves selecting specific, measurable targets for urban nature that are aligned with the long-term vision. **Targets could include metrics such as area of natural space, tree canopy, species diversity and more.** By setting interim and final targets, it's possible to measure progress and adjust the strategy as needed.

Key actions:

- ✓ Set core targets in line with national and European policies.
- ✓ Set additional targets based on the city's specific needs and opportunities.
- ✓ Ensure that targets address both environmental and social objectives (e.g. accessibility to natural areas).



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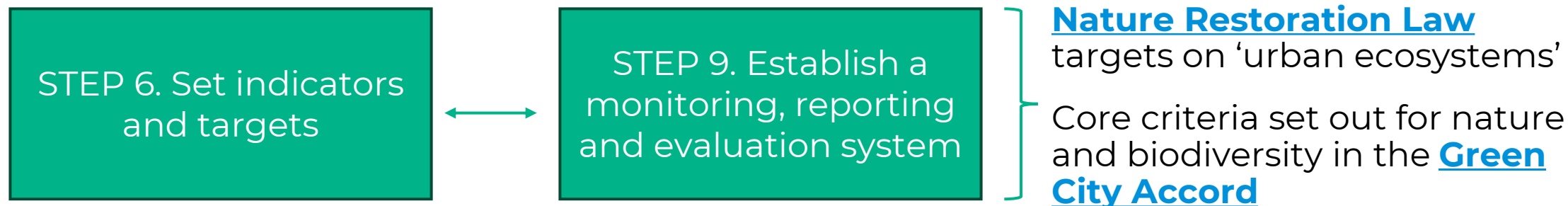
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UNP Step 6 core targets

Based on the previous steps - the agreed vision and goals of the municipality and the assessment of the current state of nature and biodiversity - now indicators can be chosen, and targets set.

Targets may be quantitative or qualitative, and are expressions of desired value, quantity, and/or quality of specific indicators.



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UNP Step 6 core targets

The set of indicators should include at least the following:

1. Percentage of urban green space (public and private) in the city and its municipality.
2. Percentage of tree canopy cover in the municipality and numbers of newly planted trees.
3. Percentage of protected natural areas on public land in the municipality.



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UNP Step 6 actions

Several locally relevant targets an/or action should be selected in the UNP.

a) Targets in relation to the balance of land use types within the urban administrative zone:

- Increase area allocated to urban farms/urban meadows/urban hedges/ urban forests; Increasing area of green roofs and walls.

b) Actions/targets to increase the abundance and richness of selected indicator species (eg. rare and endangered species, or common species that are a good indicator of ecosystem condition) / increase the **quality and quantity of habitats that support biodiversity** and/or reduce pressure on them:

- Length of tree-lined streets / Number of trees in streets, Parks, Open Spaces, on Private Property.



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UNP Step 6 actions

- c) Actions/targets to increase accessibility to public Urban green spaces:
 - Share of population that is with easy access to green areas (also private)
- d) Actions/targets to reduce the numbers and spread of existing and/or **new invasive alien species**, considering that cities are key points of entry for many alien (and potentially invasive alien) species and are also sources for secondary spread, release or escape of these species into surrounding landscapes, natural or semi-natural habitats:
 - Identification of regulated invasive alien species (plants and animals) under Union, national and local legislation that are present in the urban / peri-urban area.



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UNP Step 6 actions

e) Actions/targets on pollution in city:

- Air pollution reduction measures linked to areas adjacent to green spaces
- Light pollution reduction measures in particular near protected areas / near to biodiversity rich areas.

f) Actions addressing climate change mitigation and adaptation:

- Green walls and green roofs that contribute to increase energy efficiency.
- Use of Sustainable Drainage Systems



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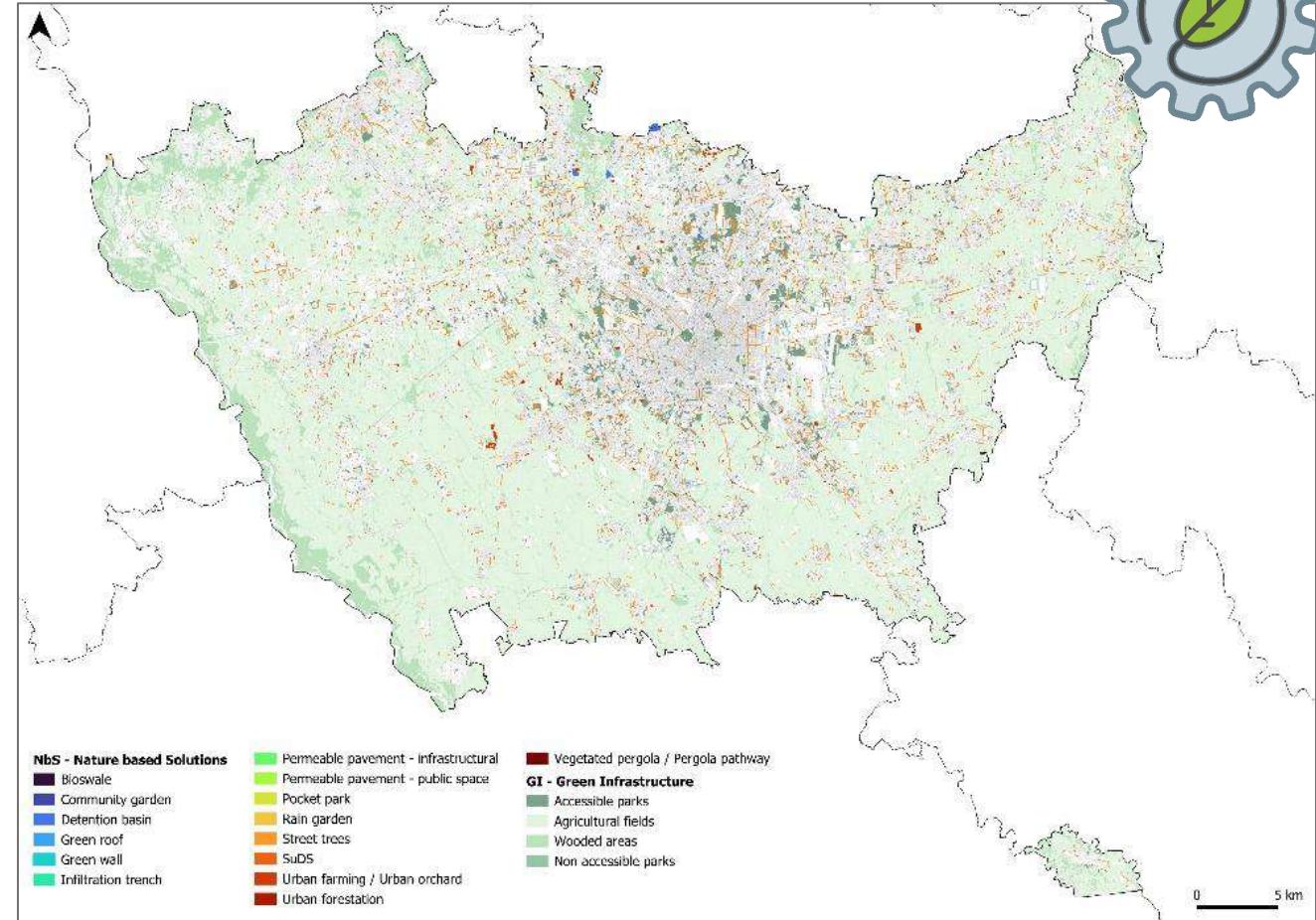


Pilot Actions

Bottom-up mapping of NbS

- **Integrated GIS-based mapping framework**
- **Multi-source spatial data integration:** Regional land-use data + municipal planning data
- **Accessibility-based green space classification:** A technical distinction between publicly accessible and non-accessible green areas was introduced through GIS processing and remote validation
- **Standardised NbS taxonomy and attribute database**
- **GreenScape CE Visual Mapping Platform for decision support**

TECHNICAL



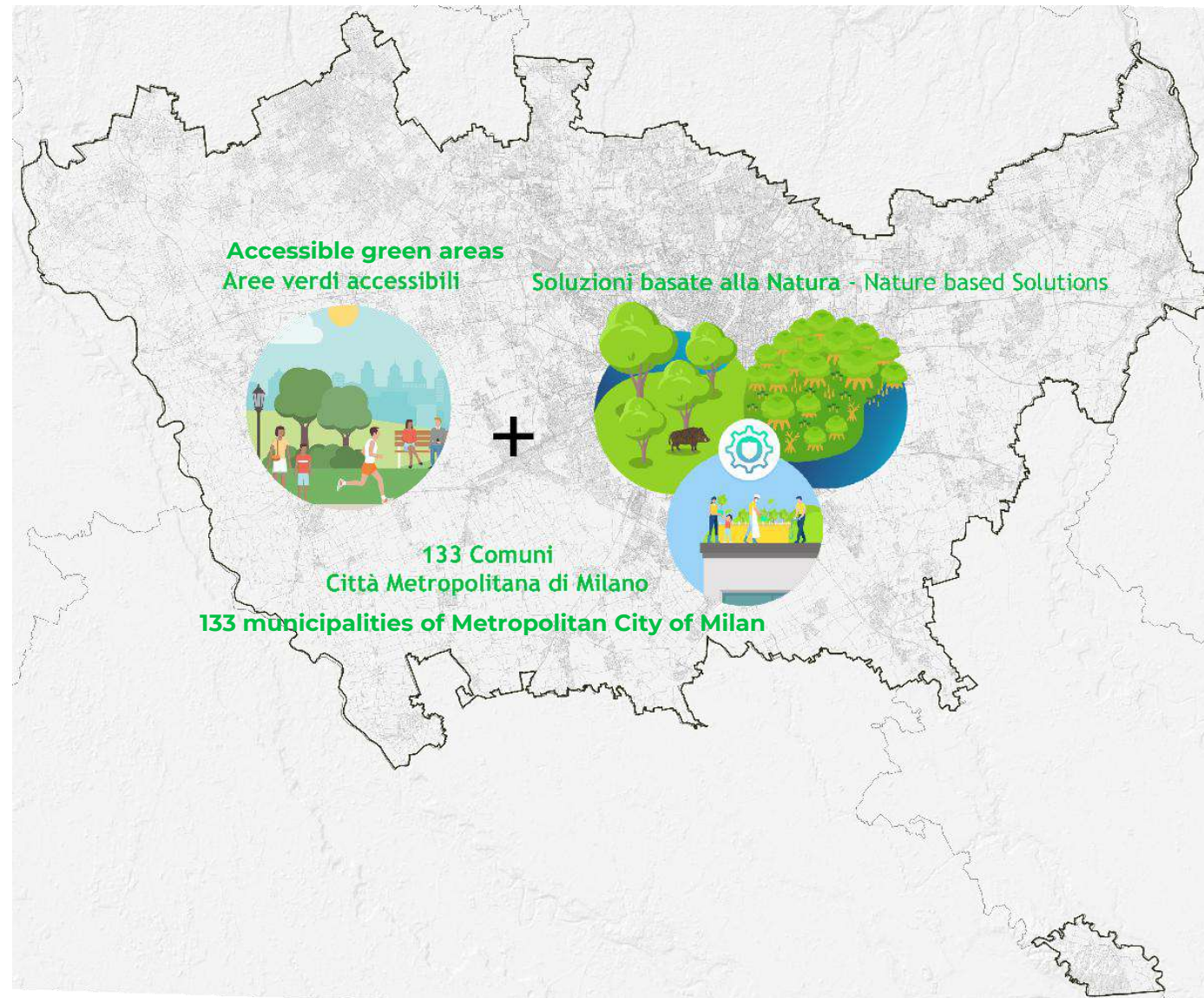
Città
metropolitana
di Milano



Il Piano Territoriale della
Città metropolitana di Milano



Conceptual framework for the integration of NbS



Identification of publicly accessible green areas

The objective is **to accurately identify parks, public gardens, and other green spaces accessible to the population**, separating them from private green areas or those not open to the public.

Regional land-use cartographic data – the DUSAF database of the Lombardy Region (used to identify the main green areas)



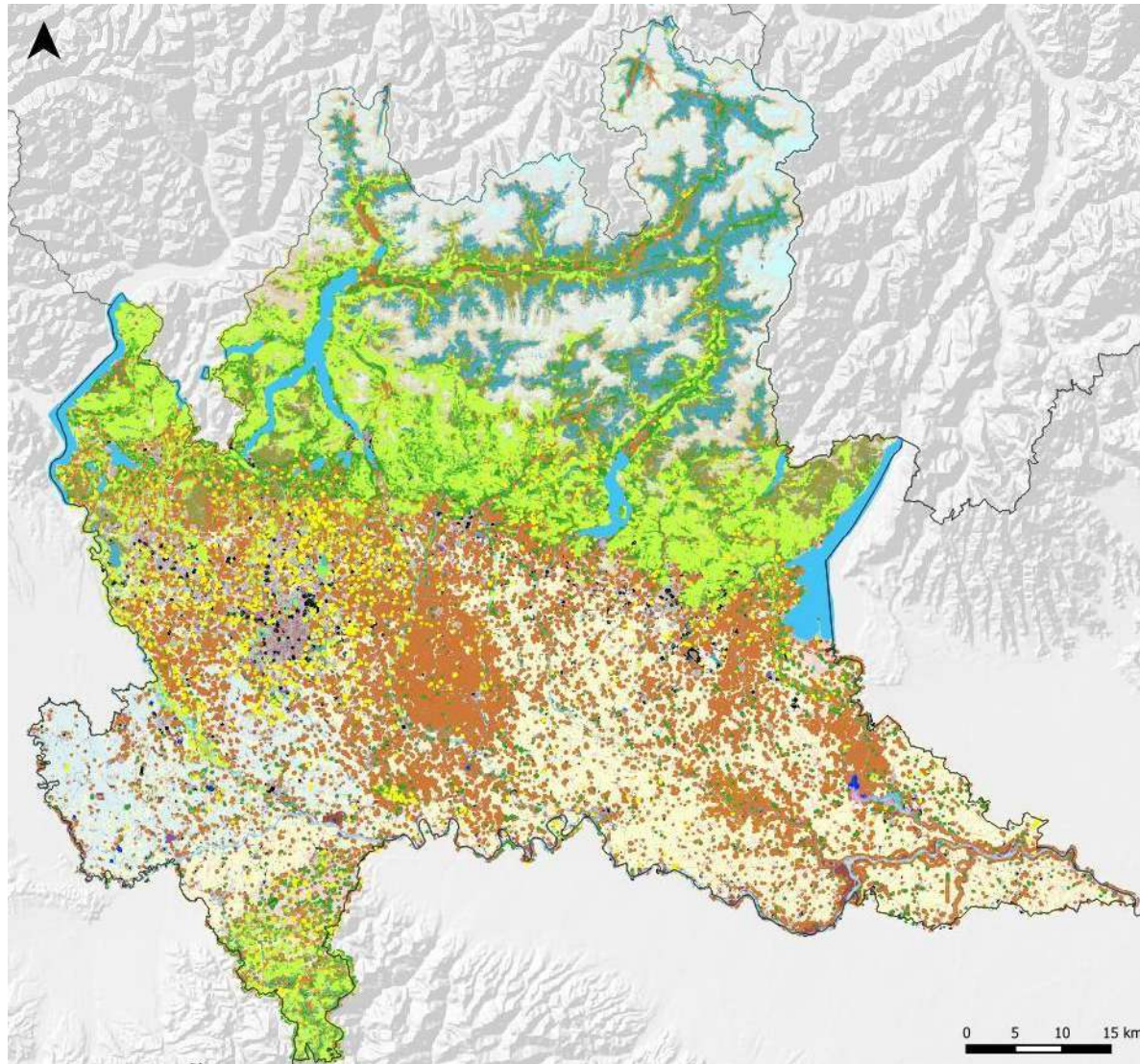
Information from Municipal Territorial Governance Plans (PGT) – municipal urban planning instruments (used to update and validate areas effectively designated as green public spaces)



Additional detailed verification was conducted using aerial imagery and tools such as Google Earth and Google Street View,
to confirm on-site the accessibility of each identified green space.



Land use of DUSAF



DUSAF7

- 1111 - tessuto residenziale denso
- 1112 - tessuto residenziale continuo mediamente denso
- 1121 - Tessuto residenziale discontinuo
- 1122 - Tessuto residenziale rado e nucleiforme
- 1123 - Tessuto residenziale sparso
- 11231 - Cascine
- 12111 - Insediamenti industriali, artigianali, commerciali
- 12112 - Insediamenti produttivi agricoli
- 12121 - Insediamenti ospedalieri
- 12122 - Impianti di servizi pubblici e privati
- 12123 - Impianti tecnologici
- 12124 - Cimiteri
- 12125 - aree militari oblitrate
- 12126 - Impianti fotovoltaici a terra
- 122 - Reti stradali, ferroviarie e spazi
- 1221 - Reti stradali e spazi accessori
- 1222 - Reti ferroviarie e spazi accessori
- 123 - Aree portuali
- 124 - Aeroporti ed eliporti
- 131 - cave
- 132 - discariche
- 133 - Cantieri
- 134 - aree degradate non utilizzate e non vegetate
- 1411 - Parchi e giardini
- 1412 - Aree verdi incolte
- 1421 - Impianti sportivi
- 1422 - Campeggi e strutture turistiche e ricettive

- 1423 - Parchi divertimento
- 1424 - Aree archeologiche
- 2111 - seminativi semplici
- 2112 - seminativi arborati
- 21131 - Colture orticole a pieno campo
- 21132 - Colture orticole protette.
- 21141 - Colture floro-vivaistiche a pieno campo
- 21142 - Colture floro-vivaistiche protette
- 2115 - orti familiari
- 213 - risaie
- 221 - vigneti
- 222 - frutteti e frutti minori
- 223 - oliveti
- 2241 - pioppeti
- 2242 - altre legnose agrarie
- 2311 - prati permanenti in assenza di specie arboree ed arbustive
- 2312 - prati permanenti con presenza di specie arboree ed arbustive sparse
- 2313 - marotte
- 3111 - boschi di latifoglie a densità media e alta
- 31111 - boschi di latifoglie a densità media e alta governati a ceduo
- 31112 - boschi di latifoglie a densità media e alta governati ad alto fusto
- 3112 - boschi di latifoglie a densità bassa
- 31121 - boschi di latifoglie a densità bassa governati a ceduo
- 31122 - boschi di latifoglie a densità bassa governati ad alto fusto
- 3113 - formazioni ripariali
- 3114 - castagneti da frutto

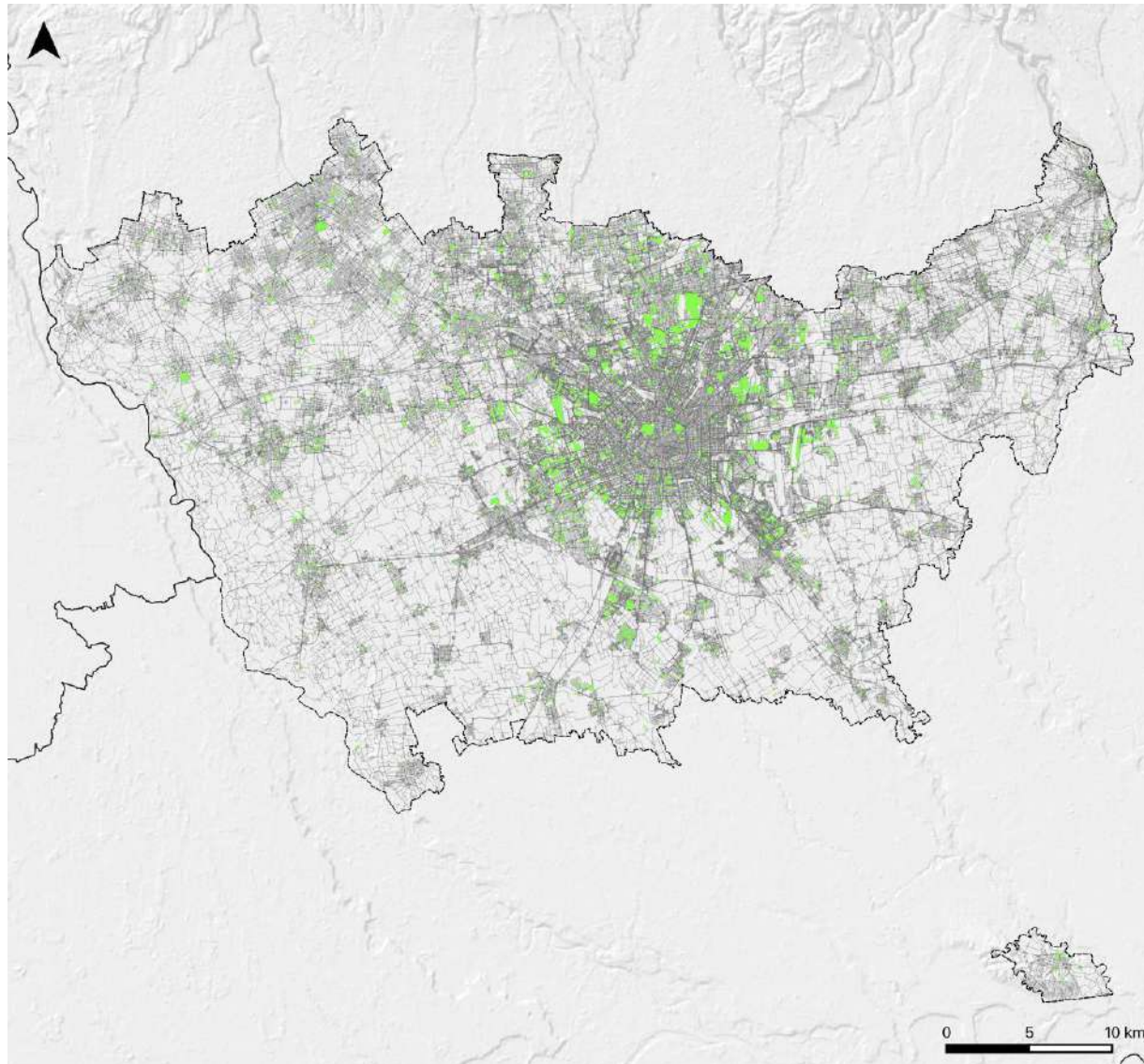
- 3121 - Boschi conifere a densità media e alta
- 3122 - Boschi di conifere a densità bassa
- 31311 - boschi misti a densità media e alta governati a ceduo
- 31312 - boschi misti a densità media e alta governati ad alto fusto
- 31321 - boschi misti a densità bassa governati a ceduo
- 31322 - boschi misti a densità bassa governati ad alto fusto
- 314 -rimboschimenti recenti
- 3211 - praterie naturali d'alta quota assenza di specie arboree ed arbustive
- 3212 - praterie naturali d'alta quota con presenza di specie arboree ed arbustive sparse
- 3221 - cespuglieti
- 3222 - vegetazione dei greti
- 3223 - vegetazione degli argini sopraelevati
- 3241 - cespuglieti con presenza significativa di specie arbustive alte ed arboree
- 3242 - cespuglieti in aree di agricole abbandonate
- 331 - spiagge, dune ed alvei ghiaiosi
- 332 - Accumuli detritici e affioramenti litoidi privi di vegetazione
- 333 - vegetazione rada
- 335 - ghiacciai e nevi perenni
- 411 - vegetazione delle aree umide interne e delle torbiere
- 511 - Alvei fluviali e corsi d'acqua artificiali
- 5121 - Bacini idrici naturali
- 5122 - Bacini idrici artificiali
- 5123 - Bacini idrici da attività estrattive interessanti la falda

DUSAF 7 – Urban greenery

1.4.1.1. Parks and gardens



Land use of DUSAF



DUSAF 7-CMM

1411 - Parchi e giardini

1.4.1.1. Parks and gardens

1. Anthropized areas

1.4 Non-agricultural green areas

1.4.1 Urban green areas

Subclass 1.4.1.1 refers exclusively to spaces intended for recreation and the well-being of the population



Integration with municipal PGTs

Since the DUSAF database, although constituting a complete and structured dataset, does not always accurately represent all publicly accessible green areas (such as neighborhood gardens or recently developed green spaces), and may also include areas not necessarily accessible to the public, such as private gardens or historic villas' parks accessible only for a fee, a detailed verification was necessary.

For this purpose, the **Territorial Governance Plans (PGTs)** of individual municipalities were analyzed, with particular reference to the **thematic maps related to public green areas**, which were compared and integrated with the data already available in the DUSAF database.



Validation of the location and the actual accessibility of the spaces



Example of non-accessible green area (Source: Google Earth)



Example of public green areas (Source: Google Earth)



Final classification of urban green areas

Green areas were divided into two macro-categories based on accessibility:

- **Public green spaces:** include both the areas identified in the DUSAF database and those integrated from the municipal PGTs. This category includes spaces accessible to the public, whether equipped (e.g. playgrounds, gardens with facilities) or not equipped.
- **Non-accessible green spaces:** include green areas not open to the public, generally privately owned or associated with economic activities (e.g. company premises, industrial areas with associated vegetation).



Output of the cartographic layer

The attribute table of the cartographic layer includes the following information:

Municipality: municipal location of the green area;

Type: macro-category of accessibility of the green area (public green space or non-accessible green space);

Main source used to verify the accessibility of the area (PGT, Google, or DUSAF).

TIPO	Comune	fonte
VERDE PUBBLICO	Motta Visconti	Google
VERDE PUBBLICO	Motta Visconti	Google
VERDE PUBBLICO	Motta Visconti	Google
VERDE PUBBLICO	Besate	PGT
VERDE NON ACCESSIBILE	Besate	PGT
VERDE NON ACCESSIBILE	Besate	PGT
VERDE PUBBLICO	Besate	PGT
VERDE PUBBLICO	Besate	PGT
VERDE PUBBLICO	Besate	PGT
VERDE PUBBLICO	Besato	PGT
VERDE PUBBLICO	Bubbiano	PGT
VERDE NON ACCESSIBILE	Bubbiano	PGT
VERDE PUBBLICO	Ozzero	PGT
VERDE PUBBLICO	Ozzero	PGT
VERDE PUBBLICO	Ozzero	PGT
VERDE PUBBLICO	Abbiategrasso	Google
VERDE PUBBLICO	Abbiategrasso	PGT
VERDE PUBBLICO	Abbiategrasso	PGT



NbS Mapping

Typologies of NbS

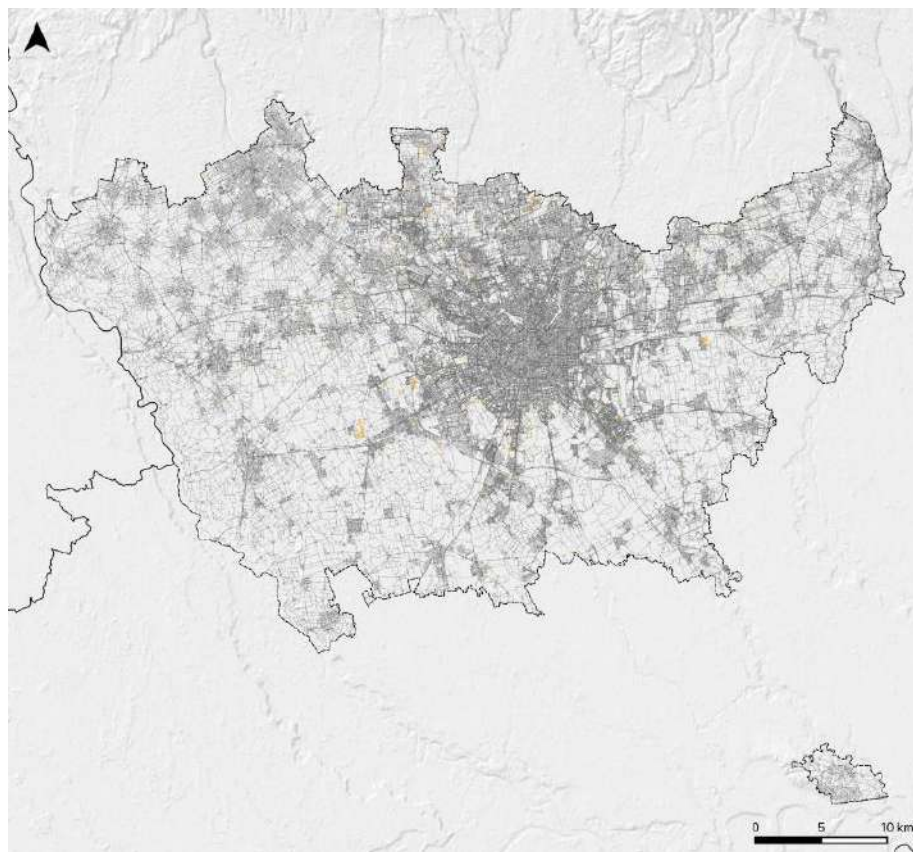
1. Infiltration trenches;
2. Green areas;
3. Ponds and wetlands
4. Environmental restoration of small urban watercourses;
5. Daylighting of culverted watercourse;
6. Pergola pathways and elevated greenery;
7. Permeable pavements;
8. Green walls;
9. Urban farming;
10. Pocket parks;
11. Community gardens;
12. Urban forestation
13. Bioswales;
14. Green barriers;
15. Detention basins;
16. Vegetated urban furniture;
17. Street trees;
18. Balcony greenery

https://www.cittametropolitana.mi.it/export/sites/default/PTM/iter/documenti/adozione/allegati_illustrativi/RVM/Abaco_NBS.pdf



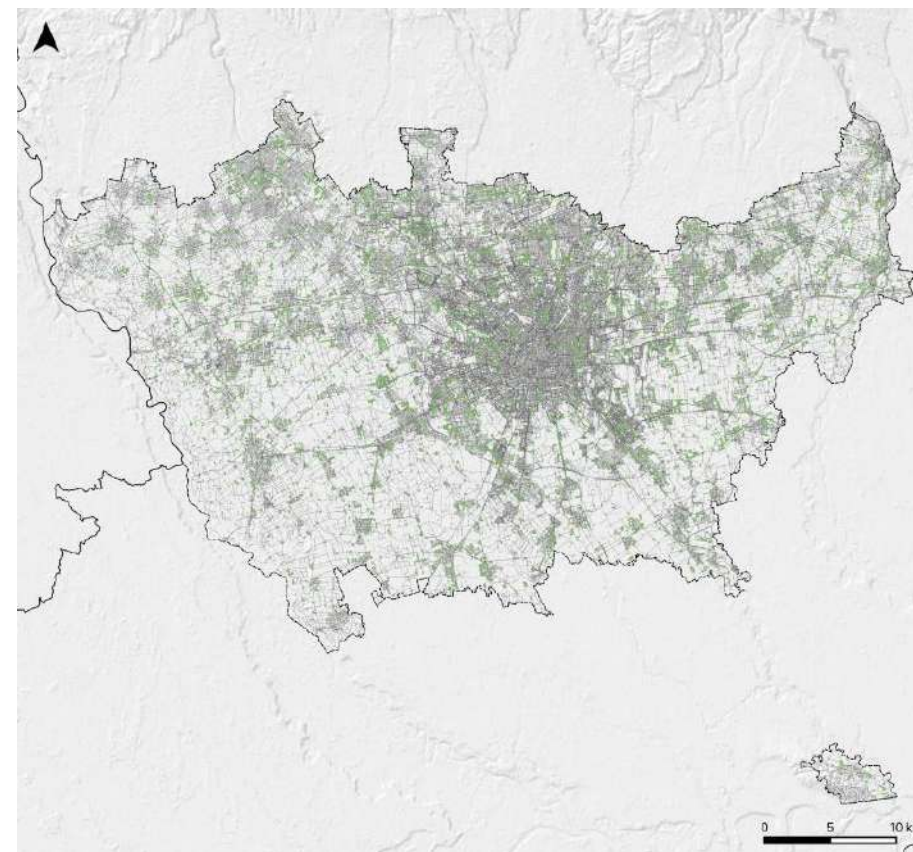
GIS processing based on DUSAF 7 - NbS

Some NbS typologies considered in the mapping project can be directly identified through the **land use information layers**.



DUSAF7 - CM Milano
2115 - orti familiari

DUSAF 7 Land Use, Level 2115 "Allotment gardens" – Lombardy Region



Filari Alberati DUSAF7

DUSAF 7 Land Use "Tree rows" – Metropolitan City of Milan



Sources and datasets used

- **CLEVER Milano Project**, aimed at testing innovative solutions for climate adaptation;
- **LIFE Metro Adapt Project**, from which the NbS typologies and part of the baseline datasets were derived;
- **The Metropolitan Urban Agenda for Sustainable Development** and its key actions within the Resilient Trajectory: NbS, Development and Research, and the Sponge City, with reference to the project funded by the PNRR funds of the European Next Generation EU programme, namely the Integrated Urban Plan (IUP) “Metropolitan Sponge City”, aimed at increasing urban drainage capacity and promoting the sustainable management of stormwater.



Sources and datasets used

For each project, the following information was collected and stored:

- Delimitation of the intervention areas;
- Main technical data;
- Design documents and descriptive reports.

The information was subsequently harmonized and aligned with a uniform classification, in order to build a consistent information base compliant with the adopted taxonomy and interoperable with the subsequent visual mapping platform.



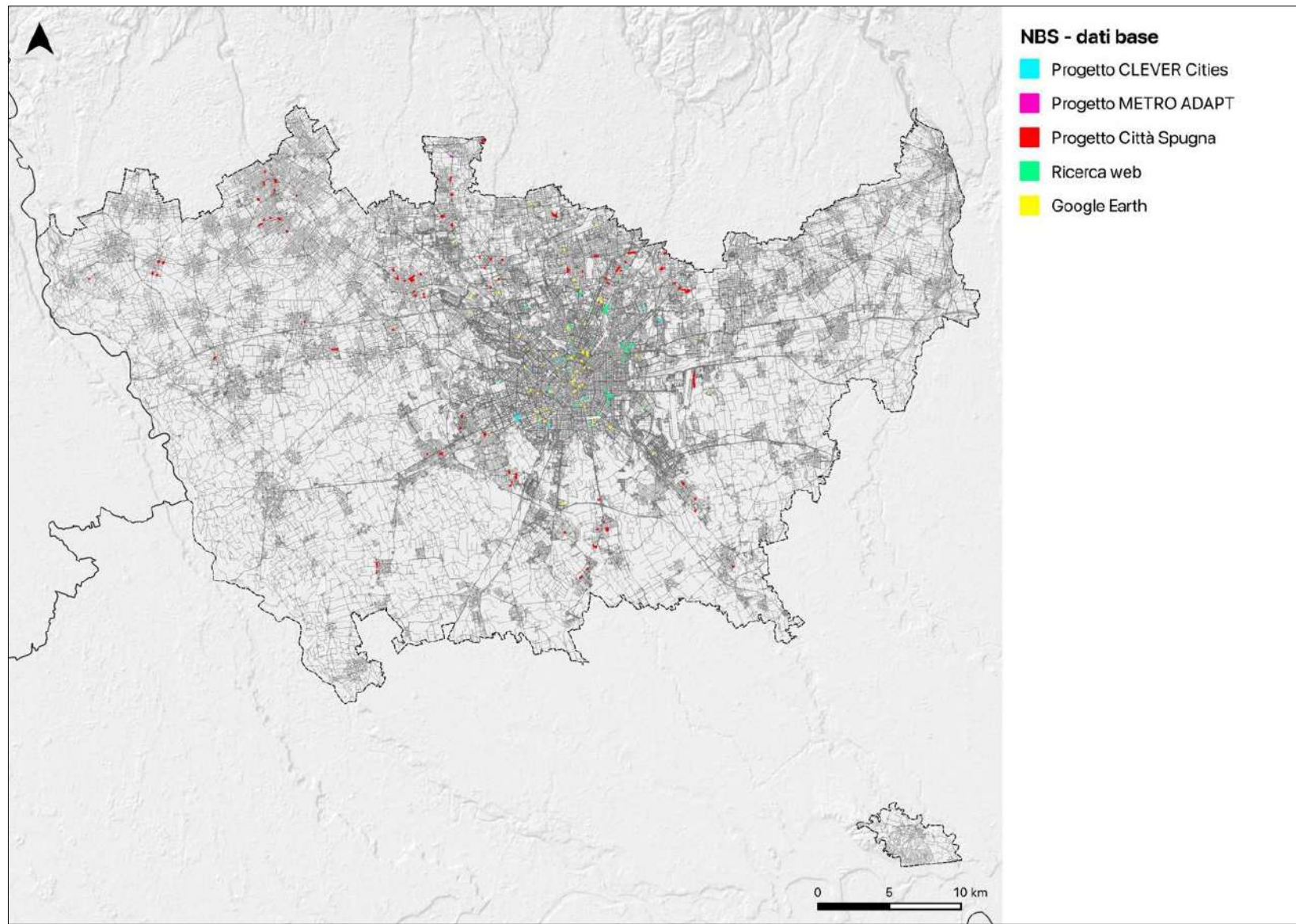
Additional desk research activities

To complement the official datasets, an exploratory desk research activity was conducted with two main objectives:

- **Spatial identification of additional projects and solutions** through the consultation of satellite imagery (Google Earth);
- **Collection of complementary information from institutional portals, websites of designers, implementing bodies, and manufacturers of specific materials related to NbS typologies.**



Additional desk research activities



NbS projects
collected in the
Metropolitan City of
Milan (updated
August 2025)



Methodology

GIS processing for the development of a base map

The initial step involved defining the **project intervention area boundary** by importing into the GIS environment the administrative boundaries of the **Metropolitan City of Milan** and all its **133 municipalities**, using georeferenced data available from the **ISTAT portal**, in particular:

- **The layer containing the boundaries of Italian municipalities**, named “Com01012025_WGS84”, filtered to include only the municipalities within the Metropolitan City;
- **The layer containing the boundaries of Italian provinces**, named “ProvCM01012025_WGS84”, filtered to include only the Province of Milan.

In addition, a **cartographic layer representing the territorial morphology and urban structure** was incorporated (CTR and DTM), retrieved from the **Geoportal of the Lombardy Region** and the **Metropolitan City**, in order to establish a suitable base for the spatial localization of individual projects. Based on this reference framework, the **boundaries of the individual projects were subsequently digitized and integrated into the GIS environment.**



Methodology

GIS processing for the development of a base map



Excerpt from the
reference cartographic
base



Methodology

Construction of the attribute table for NbS projects

- Project name
- Address
- Municipality
- NbS project area (m²)
- Scale (building, urban, peri-urban, rural, street)
- NbS typology (category based on the established taxonomy)
- NbS status (implemented, under construction, planned)
- Year of implementation (actual)
- Materials used
- Plant species (type)
- Project cost
- Previous land use
- Designer
- Material supplier
- Public accessibility (YES / NO)
- Data source



Methodology

Compilation of the attribute table for NbS projects

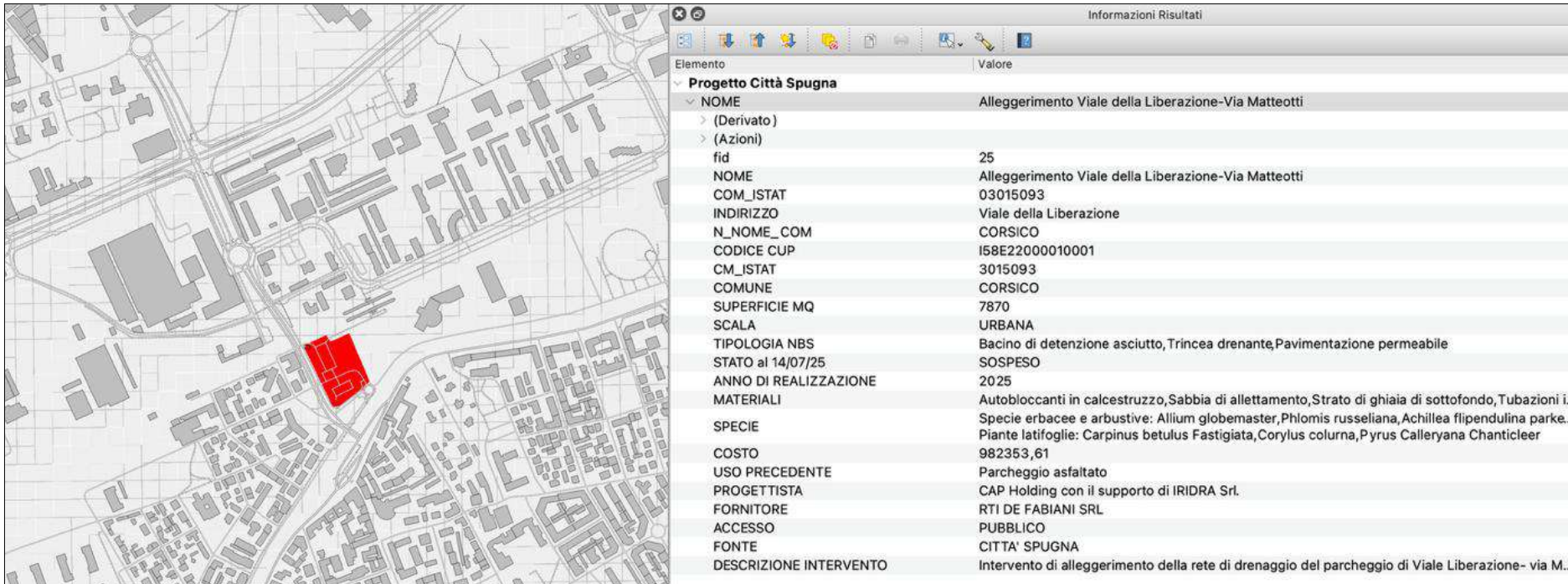
Id	CODICE CUP	NOME	CM, ISTA	INDIRIZZO	COMUNE	SUPERFICIE	SCALA	TIPOLOGIA NBS	STATO al 14/07/21	ANNO DI REALIZZAZIONE	MATERIALI	SPECIE	COSTO	USO PRECEDENTE	PROGETTISTI	FORNITORE	ACCESSO	SOURCE
89	I38E22000020001	Alleggerimento Piazza De Gasperi	3015010	Piazza De Gasperi	ARLUNO	2620	URBANA	Pavimentazioni permeabili, Trincea drenante, Area verde ribassata	REALIZZATO	2025	Calcestruzzo drenante ad alta porosità, Inerte naturale a vista (graniglia di marmo, granito o porfido), Autobloccanti in calcestruzzo vibrocompreso con fughe sfaldate, Tubazione in PVC DN 200 dotata di limitatore di portata, Geotessuto e Griglia	Liquidambar styraciflua, Taxus Baccata 'Fastigiata' e CEDRUS (cedro)	529.544,91 €	Parcheggio asfaltato	CAP Holding con il	RTI SANGALLI SPA	PUBBLICO	CITTA' SPUGNA
72	I48E22000070001	Disconnessione Via Togliatti	3015011	Via Palmiro Togliatti	ASSAGO	3540	URBANA	Area di bioritenzione, Trincea drenante, Pavimentazione permeabile	DA PROGRAMMARE	2025	Autobloccanti in calcestruzzo, Sabbia di allettamento e Strato di ghiaia	Allium globemaster, Phlox russelliana, Achillea filipendulina 'Parker', Salvia nemorosa 'Caradonna', Iris pallida 'Germanica', Echinacea alba, E. purpurea, E. pallida, Verbena bonariensis, Liatris spicata, Coreopsis lanceolata, Aster x frikartii 'Monch', Stipa gigantea, Pennisetum macrourum, Calamagrostis 'Karl Foerster'	456.610,17 €	Verde urbano	CAP Holding con il	RTI DE FABIANI SRL	PUBBLICO	CITTA' SPUGNA
76	I48E22000050001	Alleggerimento Via 1° Maggio	3015011	Via 1° Maggio - Via IV Novembre	ASSAGO	980	STRADALE	Bacino di detenzione asciutto, Trincea drenante, Pavimentazione permeabile	REALIZZATO	2024	Masselli autobloccanti in calcestruzzo, Sabbia di allettamento, Strato di ghiaia	Specie erbacee e arbustive: Allium globemaster, Phlox russelliana, Achillea filipendulina 'Parker', Salvia nemorosa 'Caradonna', Iris pallida 'Germanica', Echinacea alba, E. purpurea, E. pallida, Verbena bonariensis, Liatris spicata, Coreopsis lanceolata, Aster x frikartii 'Monch', Stipa gigantea, Pennisetum macrourum, Calamagrostis 'Karl Foerster'	113.197,80 €	Verde pubblico marginale	CAP Holding con il	RTI DE FABIANI SRL	PUBBLICO	CITTA' SPUGNA
40	I48E22000020001	Disconnessione Via Matteotti - Parcheggio tra civico 14 e 16	3015011	Via Giacomo Matteotti 14-16	ASSAGO	1610	PERIURBANA	Moduli geocellulari infiltranti, Dissolutori, appoggino con valvola a clapet	REALIZZATO	2024	Moduli geocellulari in materiale plastico rigido ad alta porosità, Materiali granulari di riempimento (pietrisco) e geotessuto filtrante, Dissolutori in calcestruzzo prefabbricato dotati di pozzetti di accesso, Tubazioni di collegamento (PVC o similari)	Alcune arboree esistenti e fari arborei	110.904,76 €	Parcheggio asfaltato	CAP Holding con il	RTI DE FABIANI SRL	PUBBLICO	CITTA' SPUGNA
43	I48E22000040001	Disconnessione Via Matteotti tratto tra il civico 16 e 18	3015011	Via Giacomo Matteotti 16-18	ASSAGO	1890	STRADALE	Moduli geocellulari infiltranti, Dissolutori, appoggino con valvola a clapet	REALIZZATO	2024	Moduli geocellulari in materiale plastico rigido ad alta porosità, Materiali granulari di riempimento (pietrisco) e geotessuto filtrante, Dissolutori in calcestruzzo prefabbricato dotati di pozzetti di accesso, Tubazioni di collegamento (PVC o similari)	Alcune arboree esistenti e fari arborei	90.892,45 €	Verde pubblico marginale	CAP Holding con il	RTI DE FABIANI SRL	PUBBLICO	CITTA' SPUGNA
75	I48E22000060001	Disconnessione Via Roma - in prossimità del cinema	3015011	Via Roma - Via Giuseppe di Vittorio	ASSAGO	3990	URBANA	Moduli geocellulari infiltranti, Dissolutori, appoggino con valvola a clapet, Sistema di trattamento e sicurezza	REALIZZATO	2024	Moduli geocellulari in plastica rigida ad alta porosità, Dissolutori prefabbricati in calcestruzzo, completi di pozzetti di accesso, Autobloccanti in calcestruzzo, Sabbia di allettamento e ghiaia per la pavimentazione permeabile, Tubazioni di collegamento (PVC o similari) e valvole a clapet per il troppo pieno	rafforzamento della componente vegetazionale urbana, senza delegare sulle essenze	339.901,57 €	Parcheggio asfaltato	CAP Holding con il	RTI DE FABIANI SRL	PUBBLICO	CITTA' SPUGNA
44	I48E22000030001	Disconnessione Via Matteotti - fronte civico 18	3015011	Via Giacomo Matteotti 18	ASSAGO	3030	PERIURBANA	Trincea drenante e pavimentazione permeabile	REALIZZATO	2024	Autobloccanti in calcestruzzo, Sabbia di allettamento, Ghiaccio di drenaggio, Geotessuto filtrante, Scarifica e tappetino bituminoso	Alcune arboree esistenti e fari arborei	202.825,11 €	Parcheggio asfaltato	CAP Holding con il	RTI DE FABIANI SRL	PUBBLICO	CITTA' SPUGNA
88	I98E22000000001	Riqualificazione Via Conciliazione - Via Eire	3015250	Via Conciliazione - Via S. Paolo	BARANZATE	4460	URBANA	Pavimentazioni permeabili, Moduli geocellulari infiltranti, Rain garden / area verde ribassata,	IN CORSO	2025	Autobloccanti in calcestruzzo vibrocompreso a fughe strette con pietrisco, Asfalto per corselli canalicati, con sezione a 'schiena d'asino' per convogliare le acque ai punti di raccolta, Pietra naturale, Moduli geocellulari in polipropilene, Geotessuto in PP ad alta permeabilità, Ghiaia vagliata, Pozzetti ispezionabili in polietilene con chiusura ventilata e filo di raccolta, Piano di sedute in cemento	Per le nuove piantumazioni sono state scelte specie autoctone, coerenti con la serie vegetazionale locale, a basso consumo idrico e ad elevata resistenza agli stress ambientali	1.579.792,53 €	Parcheggio asfaltato	CAP Holding con il	RTI SANGALLI SPA	PUBBLICO	CITTA' SPUGNA



Methodology

Linking the attribute table for NbS projects to the corresponding project boundaries

This operation was carried out using a unique numeric identifier (ID) included in the attribute table and a join function available in the GIS environment, which allows project-related data to be linked with spatial data.



Elemento	Valore
Progetto Città Spugna	
NOME	Alleggerimento Viale della Liberazione-Via Matteotti
> (Derivato)	
> (Azioni)	
fid	25
NOME	Alleggerimento Viale della Liberazione-Via Matteotti
COM_ISTAT	03015093
INDIRIZZO	Viale della Liberazione
N_NOME_COM	CORSICO
CODICE CUP	I58E22000010001
CM_ISTAT	3015093
COMUNE	CORSICO
SUPERFICIE MQ	7870
SCALA	URBANA
TIPOLOGIA NBS	Bacino di detenzione asciutto, Trincea drenante, Pavimentazione permeabile
STATO al 14/07/25	SOSPESO
ANNO DI REALIZZAZIONE	2025
MATERIALI	Autobloccanti in calcestruzzo, Sabbia di allettamento, Strato di ghiaia di sottofondo, Tubazioni i...
SPECIE	Specie erbacee e arbustive: Allium globemaster, Phlomis russeliana, Achillea filipendulina parke...
COSTO	982353,61
USO PRECEDENTE	Parcheggio asfaltato
PROGETTISTA	CAP Holding con il supporto di IRIDRA Srl.
FORNITORE	RTI DE FABIANI SRL
ACCESSO	PUBBLICO
FONTE	CITTA' SPUGNA
DESCRIZIONE INTERVENTO	Intervento di alleggerimento della rete di drenaggio del parcheggio di Viale Liberazione- via M...



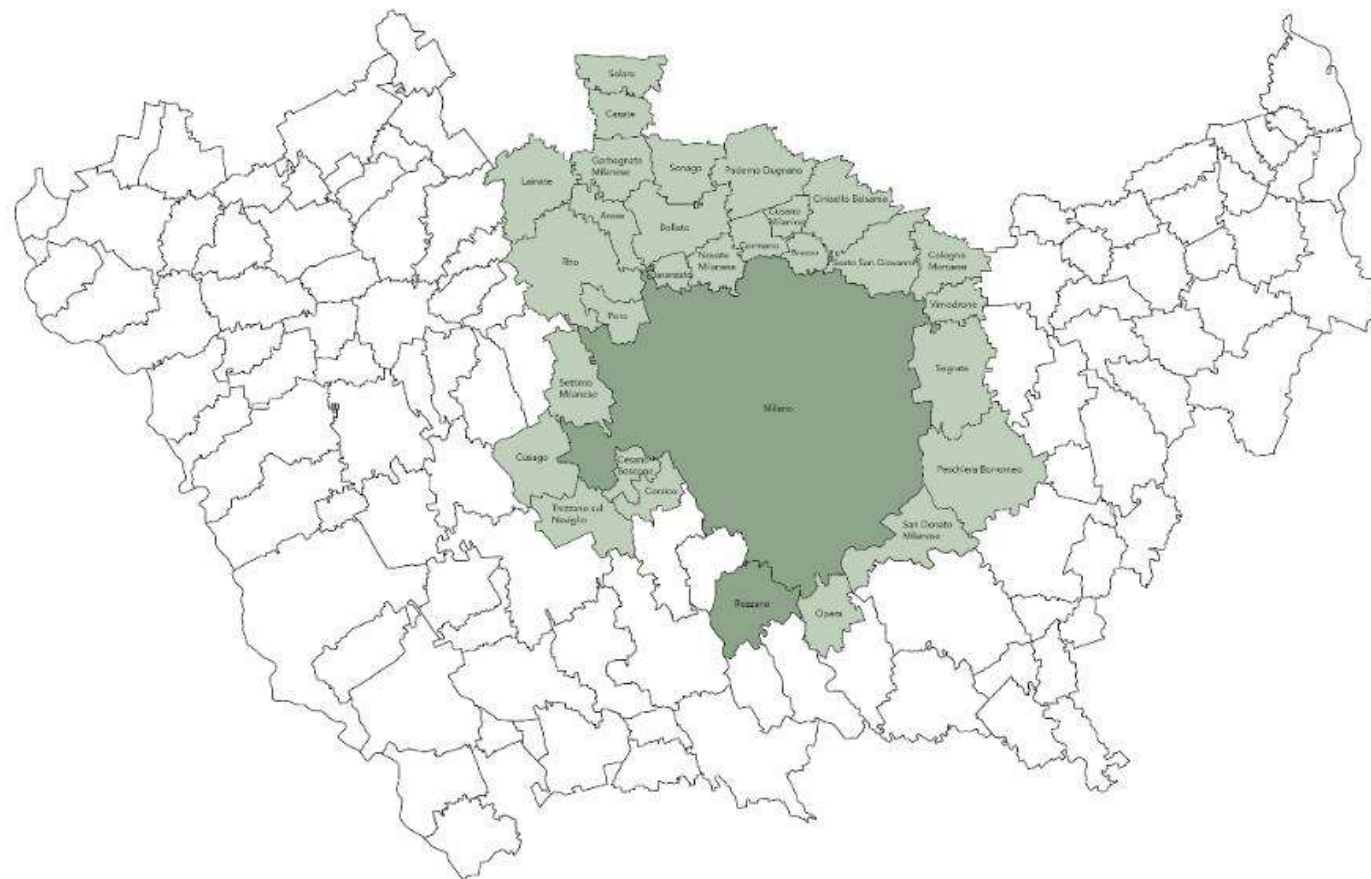
Focus on green roofs and green walls

Data sources used

- Google Maps / Google Earth (2023 imagery)
- On-site inspections
- Photographic documentation
- Questionnaires voluntarily completed by architects and local residents (European project CLEVER Cities)
- Websites of suppliers and engineering/architecture companies (e.g. ZinCo, Harpo, Sempergreen, DAKU, MM S.p.A., Montana S.p.A.)
- The public uMap (OpenStreetMap) published by the Comune di Milano, titled “Map of Works - Department of Environment and Green Areas”



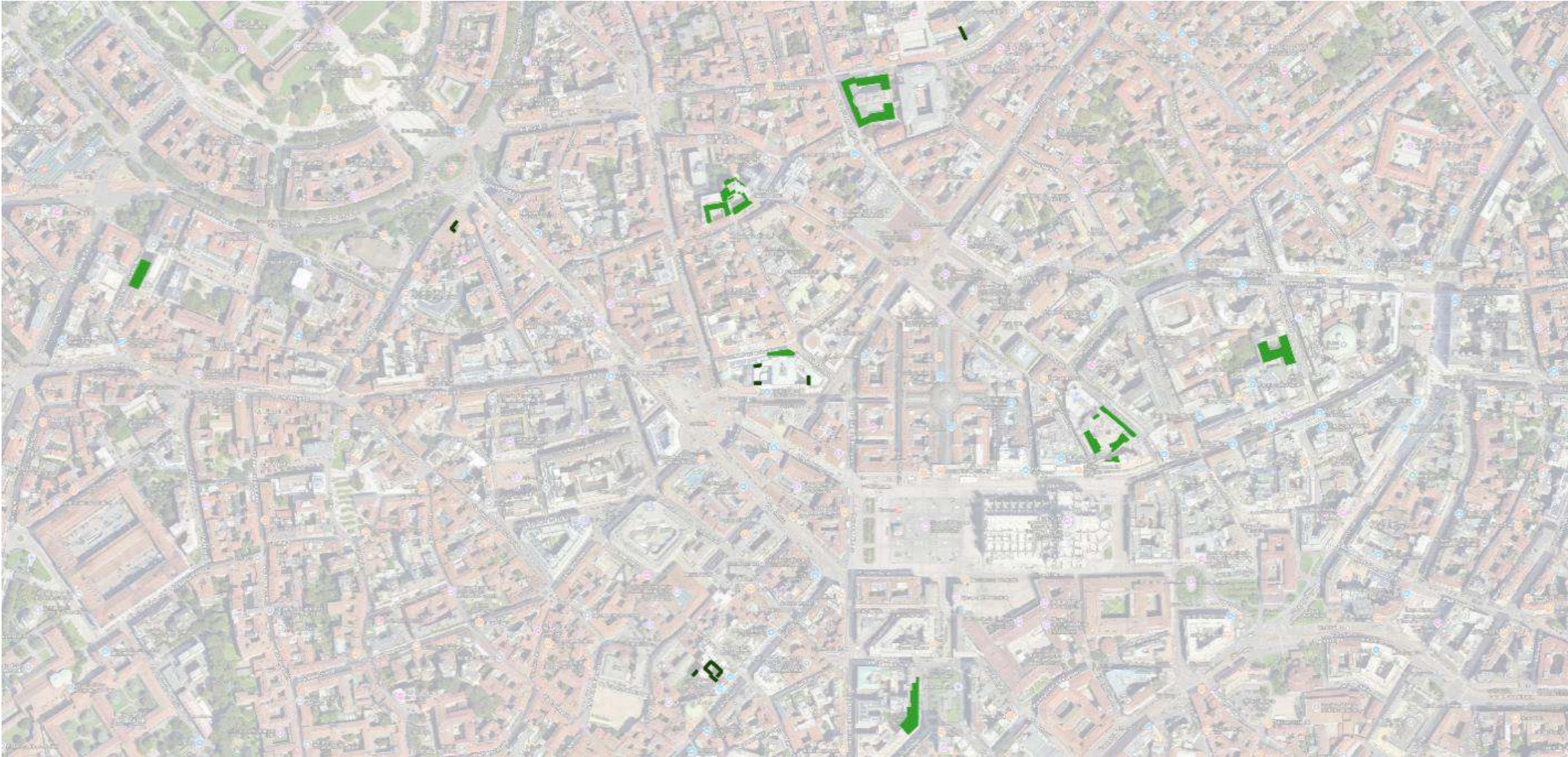
Green roofs and walls



- TETTI VERDI E PARETI VERDI
- TETTI VERDI



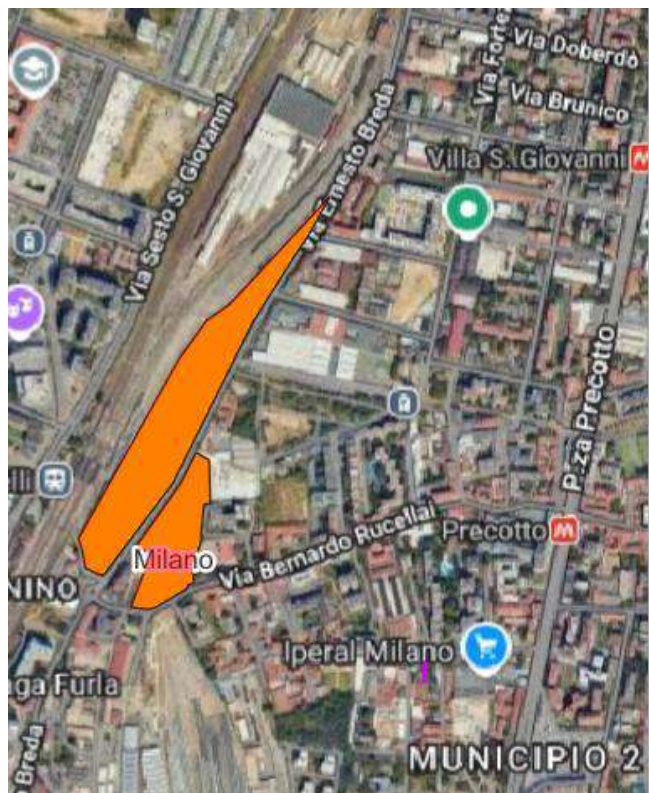
Green roofs and walls



Close-up view of the mapped area, showing examples of green roofs and green walls identified in the dataset



Green roofs and walls - limitations



Feature	Value
NBS - CMM	
INDIRIZZO	Via Ernesto Breda, 20126 Milano MI
(Derived)	
(Actions)	
SUPERFICIE	73500 (la superficie complessiva del progetto)
SCALA	URBANA
TIPOLOGIA	TETTO VERDE, TRINCEA DRENANTE, PAVIMENTAZIONI PERMEABILI, ORTI URBANI SOSTENIBILI, GIARDINI CONDIVISI
STATO	IN CORSO
ANNO	NULL
COSTO	NULL
DEST USO	Inutilizzato o in stato di degrado
PROG	Barreca & La Varra
ACCESSO	PUBBLICA E PRIVATA
FONTE	Reinventing Cities
SPECIE	Piante Erbacee, Fiori, Erbe Officinali, Salici, Pioppi, Ontani, Insetti Pronubi
INDIRIZZO	Via Ernesto Breda, 20126 Milano MI
MATERIAL	Legno, Acciaio, Calcestruzzo
FORNITORE	Wood Beton
NAME	L'innesto

Overview of the L'Innesto project area, illustrating the integrated NbS of different typologies within the total mapped area

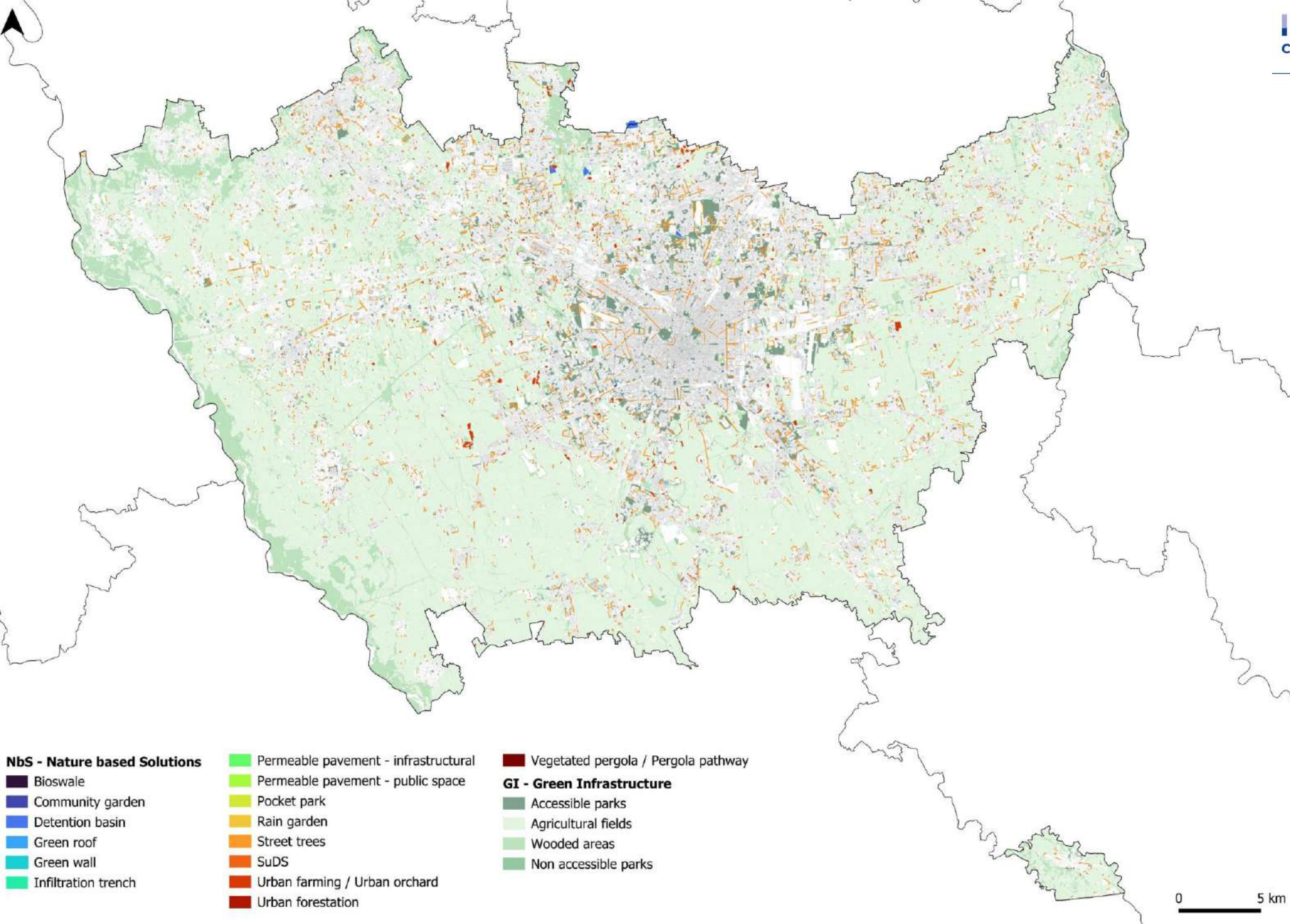


Green roofs and walls - limitations



Some interventions were originally part of high-profile and well-designed projects, such as the green wall at Monte dei Paschi di Siena, but have since experienced deterioration due to inadequate maintenance, irrigation, or management. These sites were nonetheless included in the inventory.





NbS - Nature based Solutions

- Bioswale
- Community garden
- Detention basin
- Green roof
- Green wall
- Infiltration trench

GI - Green Infrastructure

- Permeable pavement - infrastructural
- Permeable pavement - public space
- Pocket park
- Rain garden
- Street trees
- SuDS
- Urban farming / Urban orchard
- Urban forestation

GI - Green Infrastructure

- Vegetated pergola / Pergola pathway
- Accessible parks
- Agricultural fields
- Wooded areas
- Non accessible parks

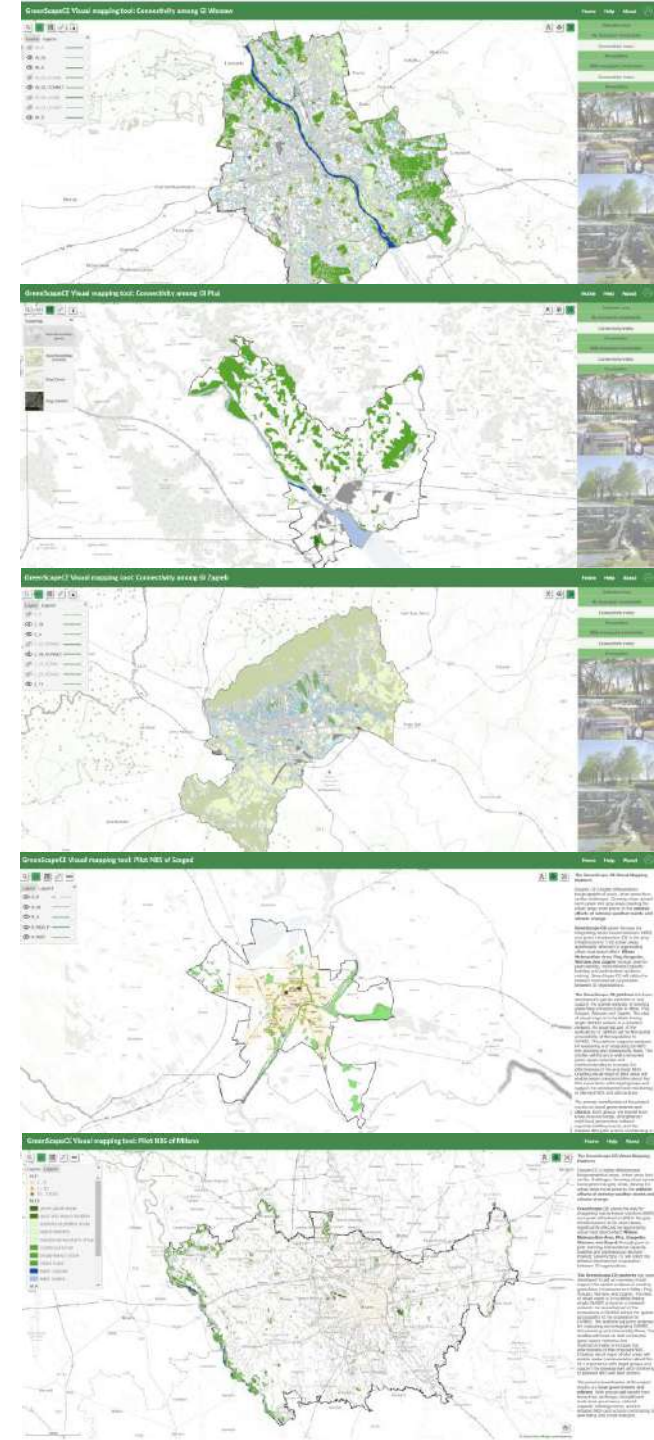
0 5 km



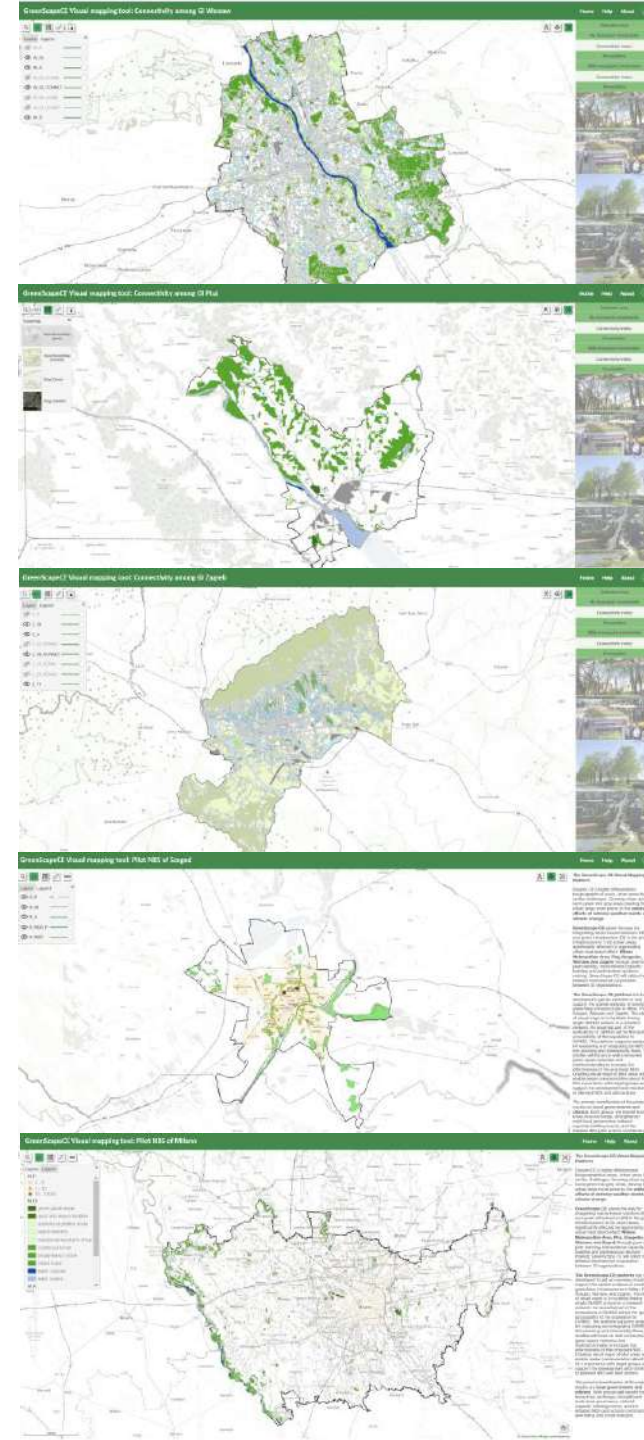
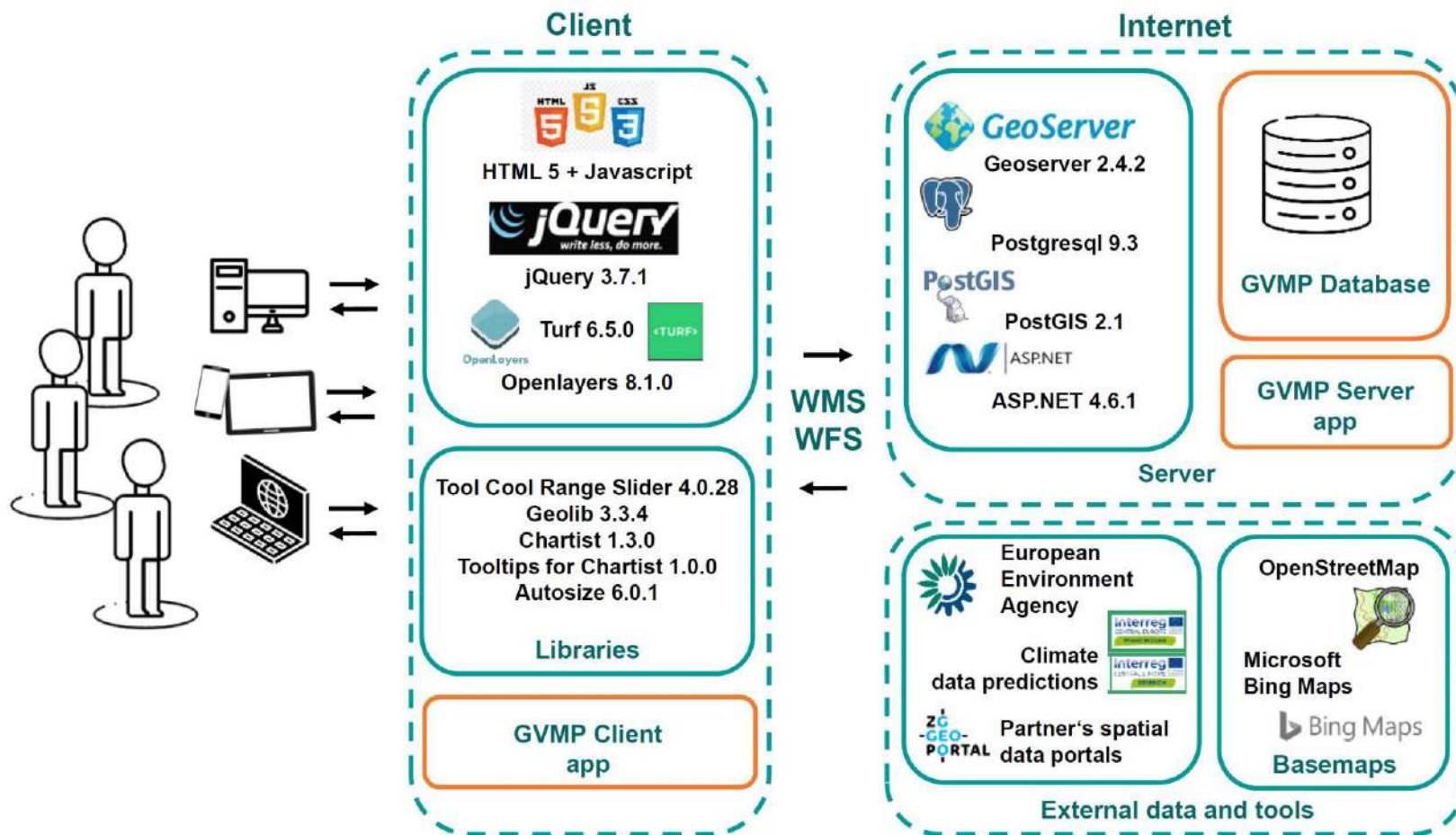
Visual maps

- Maps that identify existing areas of NbS and potential ones
- An open source platform
- Enable a simple e direct communication with the citizens on the importance of NbS
- Support the design and the development of NbS project as well as of the action plans
- Support the monitoring of the positive impacts of NbS projects already implemented
- Linked to the quality air values etc.

www.greenscapece.visualmapping.eu

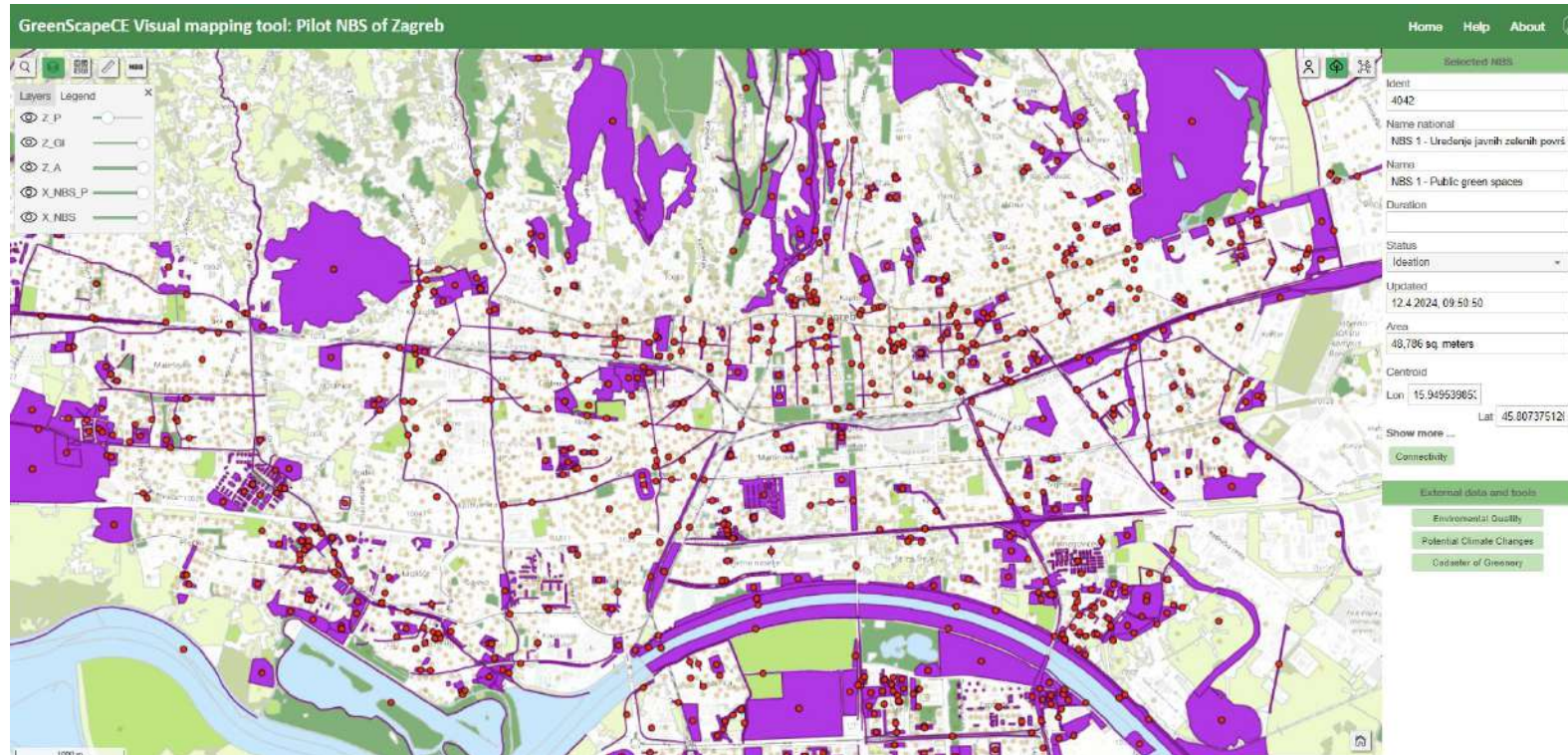


GreenScape Visual Mapping Platform

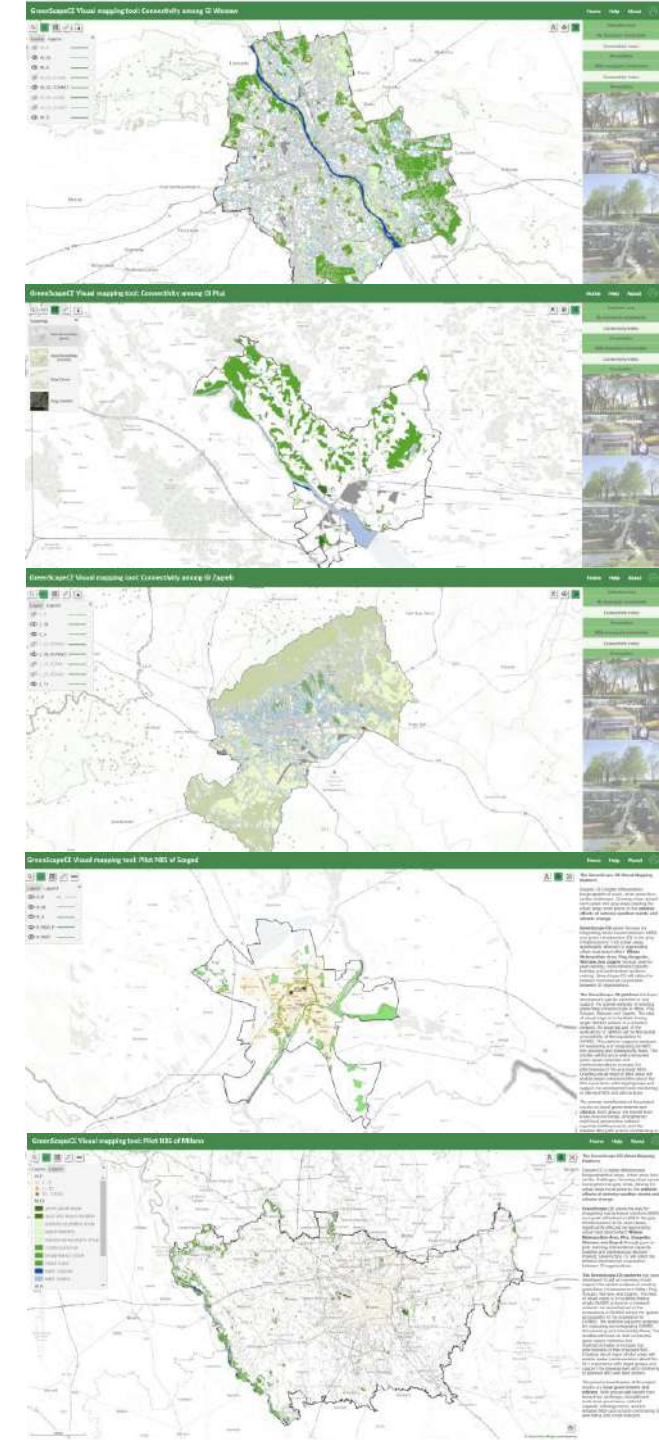


www.greenscapece.visualmapping.eu

NBS tool



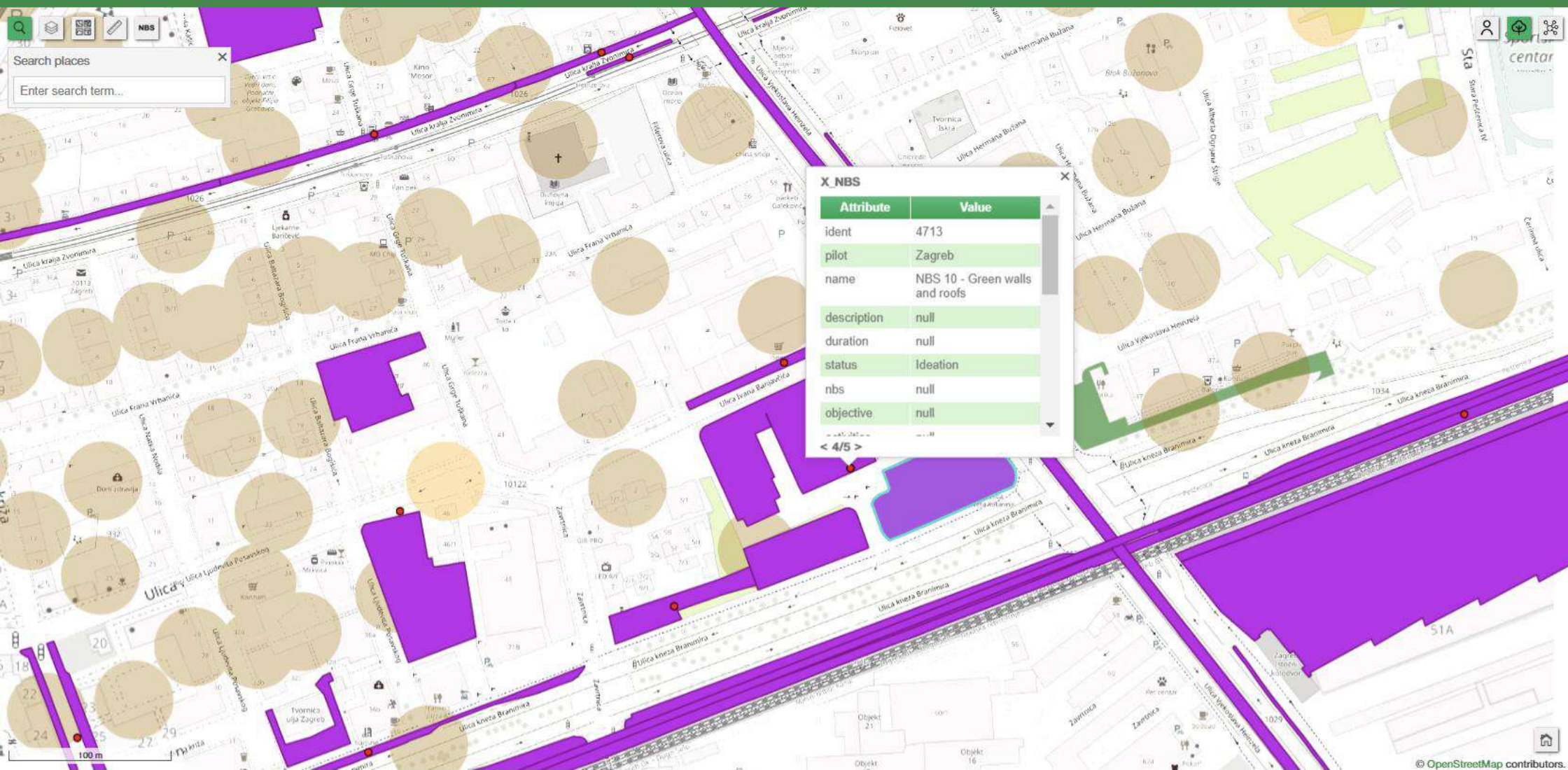
The NBS tool contains data related to individual NBS, geographic data (polygons and central points), and attribute data. It can be used in different phases of NBS planning and management: from the conceptualization and planning of the overall NBS system in the pilot city, to the prioritization of interventions; from the analysis of compatibility with existing green infrastructure, to the assessment of the impact of already implemented NBS; up to the calculation of connectivity between the different elements of the system.



NBS tool

GreenScape CE

GreenScapeCE Visual mapping tool: Pilot NBS of Zagreb

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face similar challenges. Growing urban sprawl turns green into grey areas, leaving the urban areas more prone to the **adverse effects of extreme weather events and climate change**.

GreenScape CE paves the way for integrating nature-based solutions (NBS) and green infrastructure (GI) in the grey infrastructure in 5 CE urban areas, significantly affected by aggravating urban heat island effect: **Milano Metropolitan Area, Ptuj, Szegedin, Warsaw, and Zagreb** through peer-to-peer learning, transnational capacity building and participatory decision-making. **GreenScape CE** will utilize the initiated international cooperation between 33 organizations.

The GreenScape CE platform has been developed to get an overview of and support the spatial analyses of existing green/blue infrastructures in Milan, Ptuj, Szeged, Warsaw, and Zagreb. The idea of visual maps is to facilitate linking single GI/NBS actions in a coherent network. An essential part of the evaluations of GI/NBS will be the spatial accessibility of the population to GI/NBS. The platform supports analyses for evaluating and integrating GI/NBS into planning and stewardship flows. The studies will focus on well-connected green space networks and multifunctionality to increase the effectiveness of the proposed NBS. Creating visual maps of pilot areas will enable easier communication about the GI's importance with target groups and support the development and monitoring of planned NBS and pilot actions.

The primary beneficiaries of the project results are **local governments and citizens**. Both groups will benefit from know-how exchange, strengthened multi-level governance, tailored capacity-building events, and the initiated NBS pilot actions contributing to well-being and social inclusion.

NBS tool

GreenScape CE

GreenScapeCE Visual mapping tool: Pilot NBS of Zagreb

Home Help About

NBS editing tools

Select Create

Status

Ideation

Updated

12.4.2024, 09:50:50

Area

5,575 sq. meters

Centroid

Lon 16.001443325

Lat 45.809350124

Show more ...

Connectivity

Selected NBS

Ident 4714

Name national NBS 10 - Primjena zelenih zidova i krc

Name NBS 10 - Green walls and roofs

Duration

Status Ideation

Updated 12.4.2024, 09:50:50

Area 5,575 sq. meters

Centroid

Lon 16.001443325

Lat 45.809350124

Show more ...

External data and tools

Environmental Quality

Potential Climate Changes

Cadaster of Greenery

External data and tools

Environmental Quality

Potential Climate Changes

Cadaster of Greenery

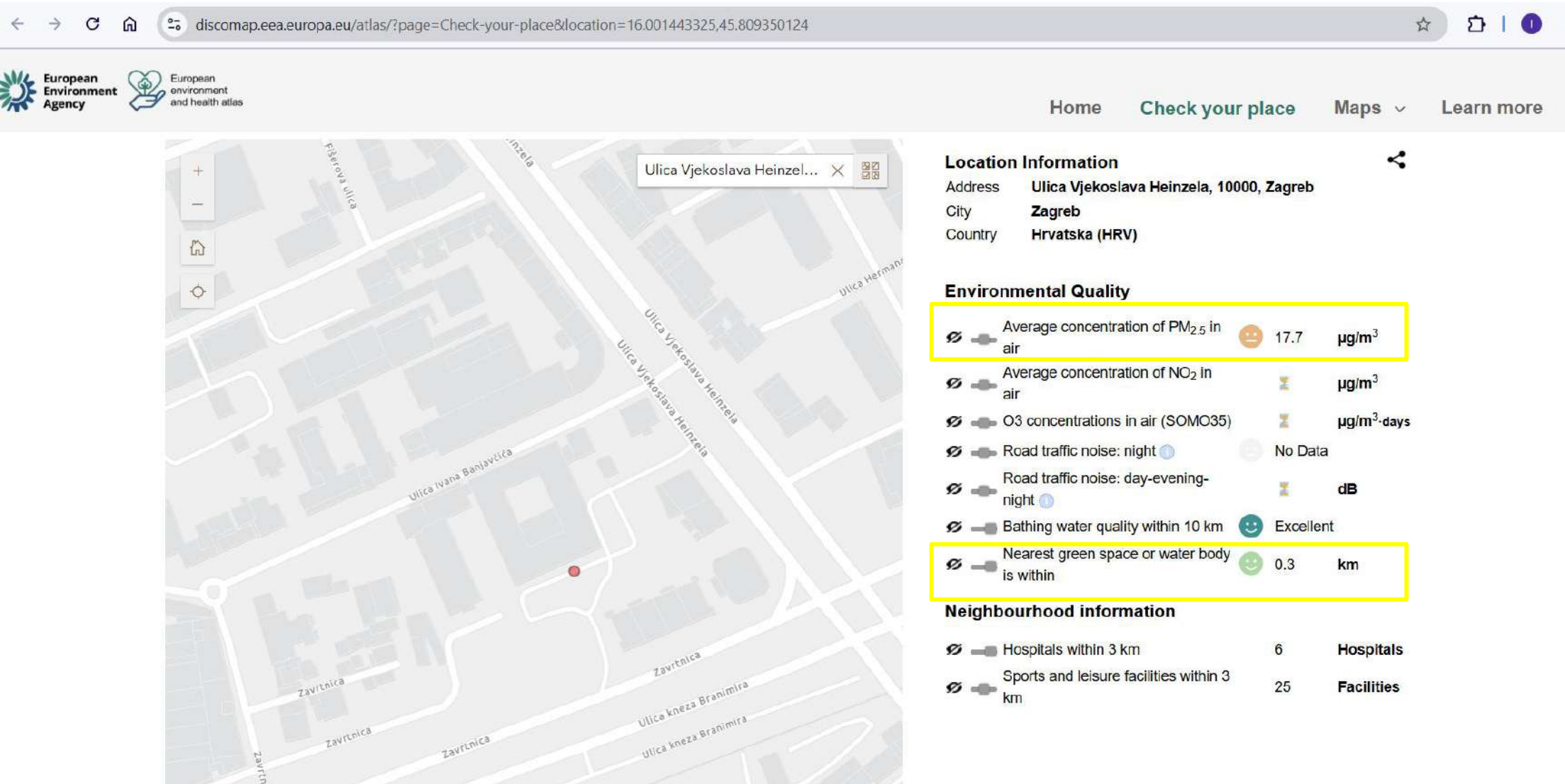
Environmental quality - EEA

External data and tools

Environmental Quality

Potential Climate Changes

Cadaster of Greenery



Potential climate changes

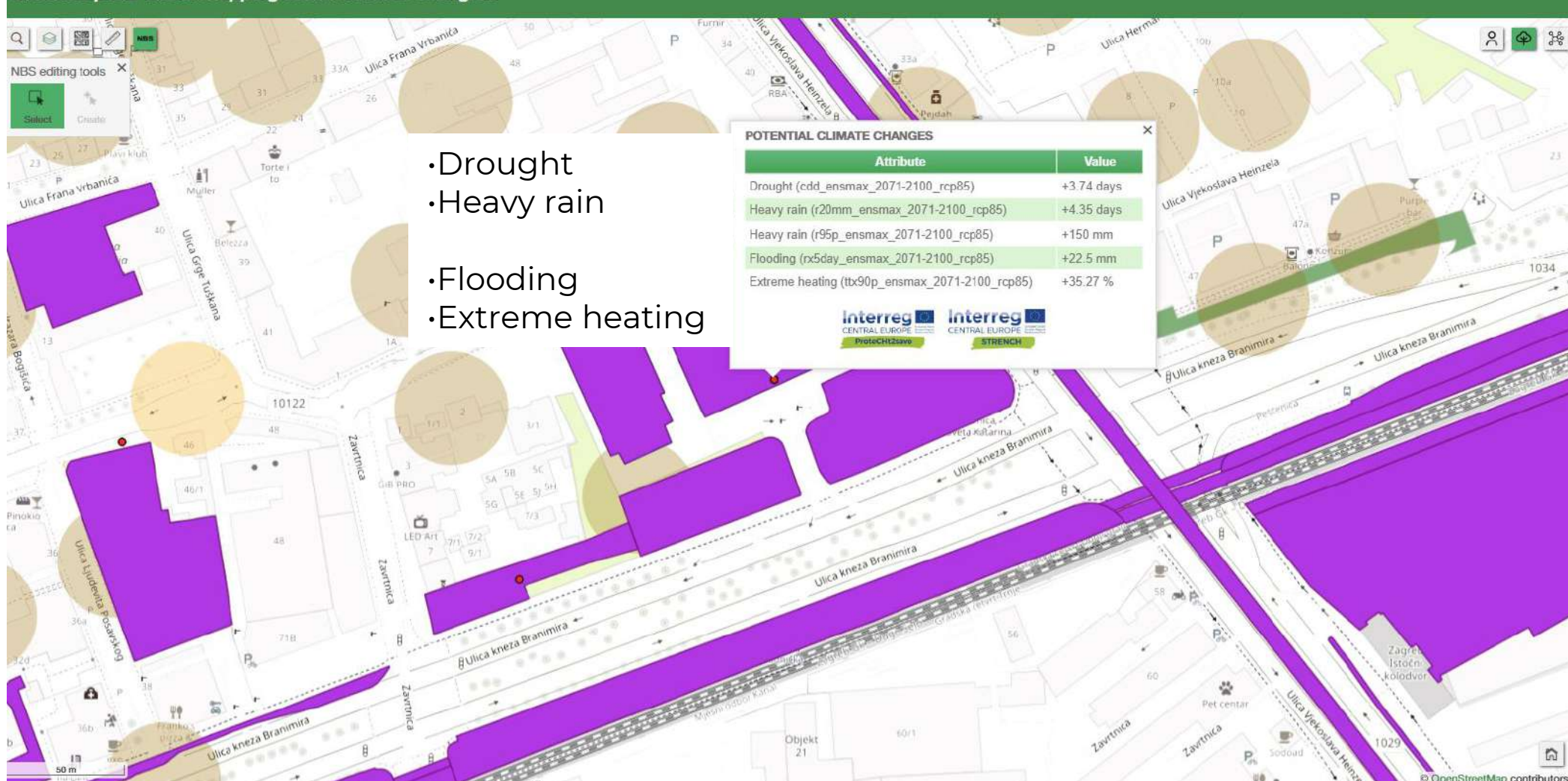
External data and tools

Environmental Quality

Potential Climate Changes

Cadaster of Greenery

GreenScapeCE Visual mapping tool: Pilot NBS of Zagreb



- Drought
- Heavy rain
- Flooding
- Extreme heating

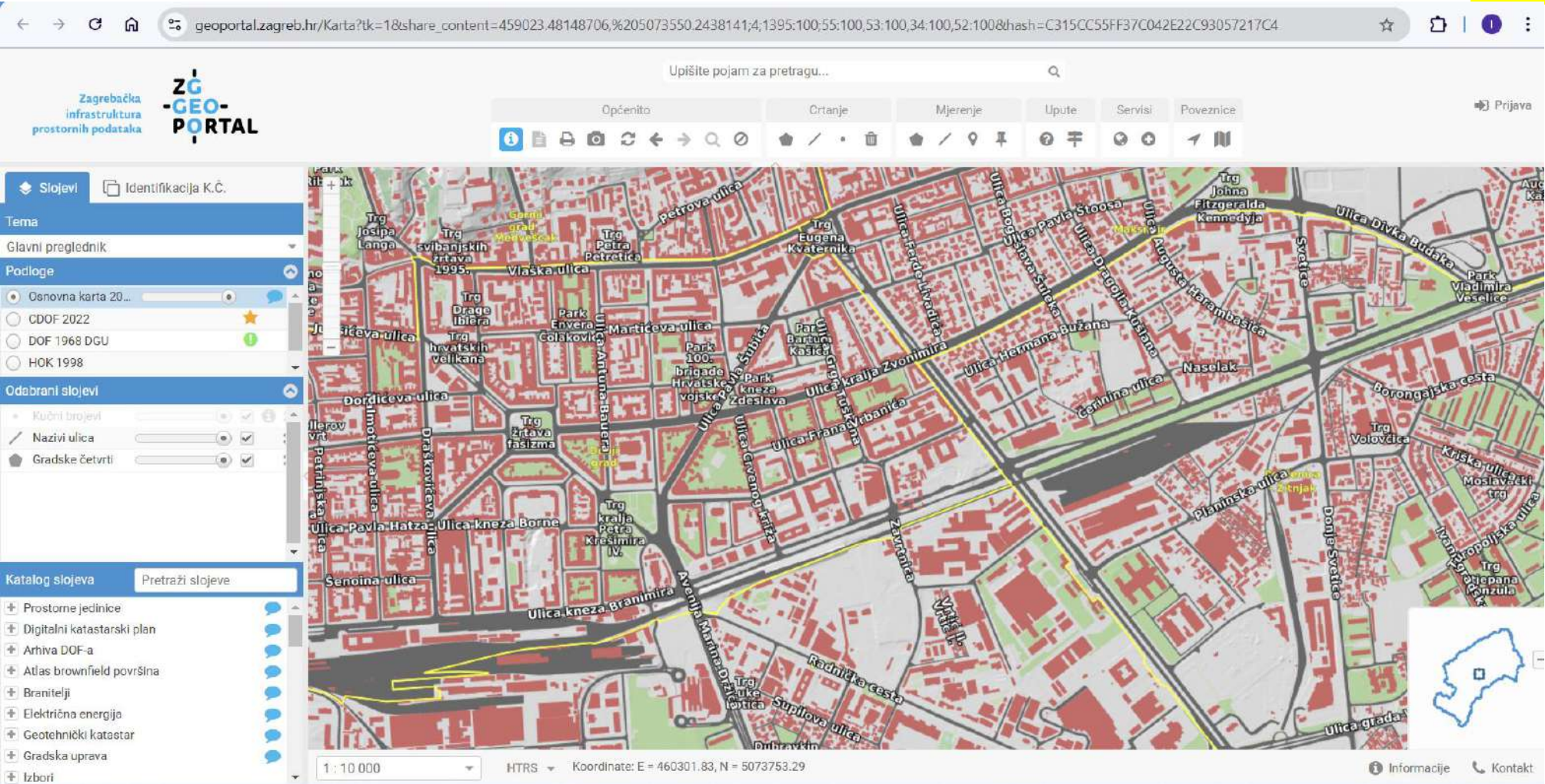
Cadaster of Green Area

External data and tools

Enviromental Quality

Potential Climate Changes

Cadaster of Greenery



The screenshot displays the GreenScapeCE Visual mapping tool interface for Zagreb. The main map area shows a street map of Zagreb with numerous green dots representing green spaces. A sidebar on the left provides summary statistics and charts, while a sidebar on the right shows a list of green spaces with their names and distances to the nearest GI.

Summary Statistics (Left Sidebar):

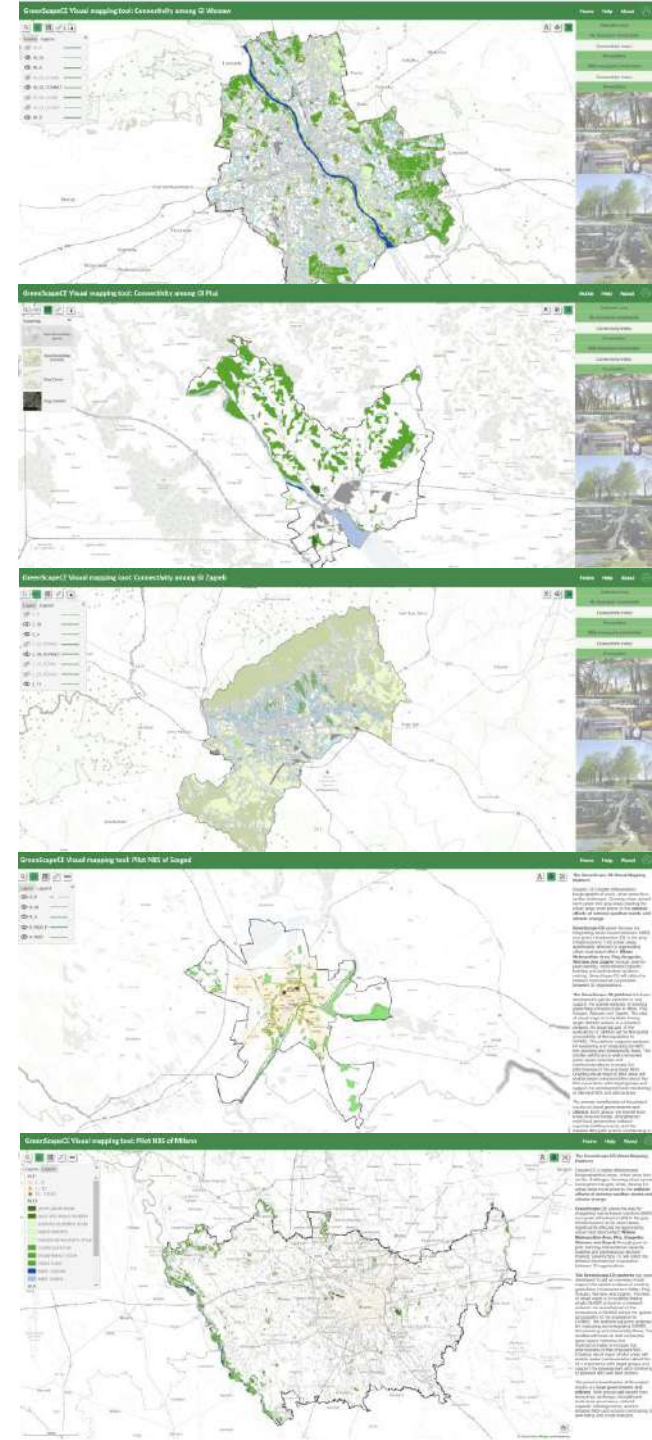
- Zagreb**
- Area: 641.342 km²
- Population: 707,131
- GI per inhabitant: 638 m²
- Average distance to nearest GI: 161 m
- Distance to nearest GI: [Bar chart showing distribution of distances]
- Types of GI: [Pie chart showing distribution of green space types]

Green Space List (Right Sidebar):

GI name	Distance to nearest GI
"Silvije Strahimira Kranjčević"	178.41
Trešnjevka - sjever	13
population total	13
distance to nearest GI	20
population total men	0
population total women	0
area 0 - 4	0

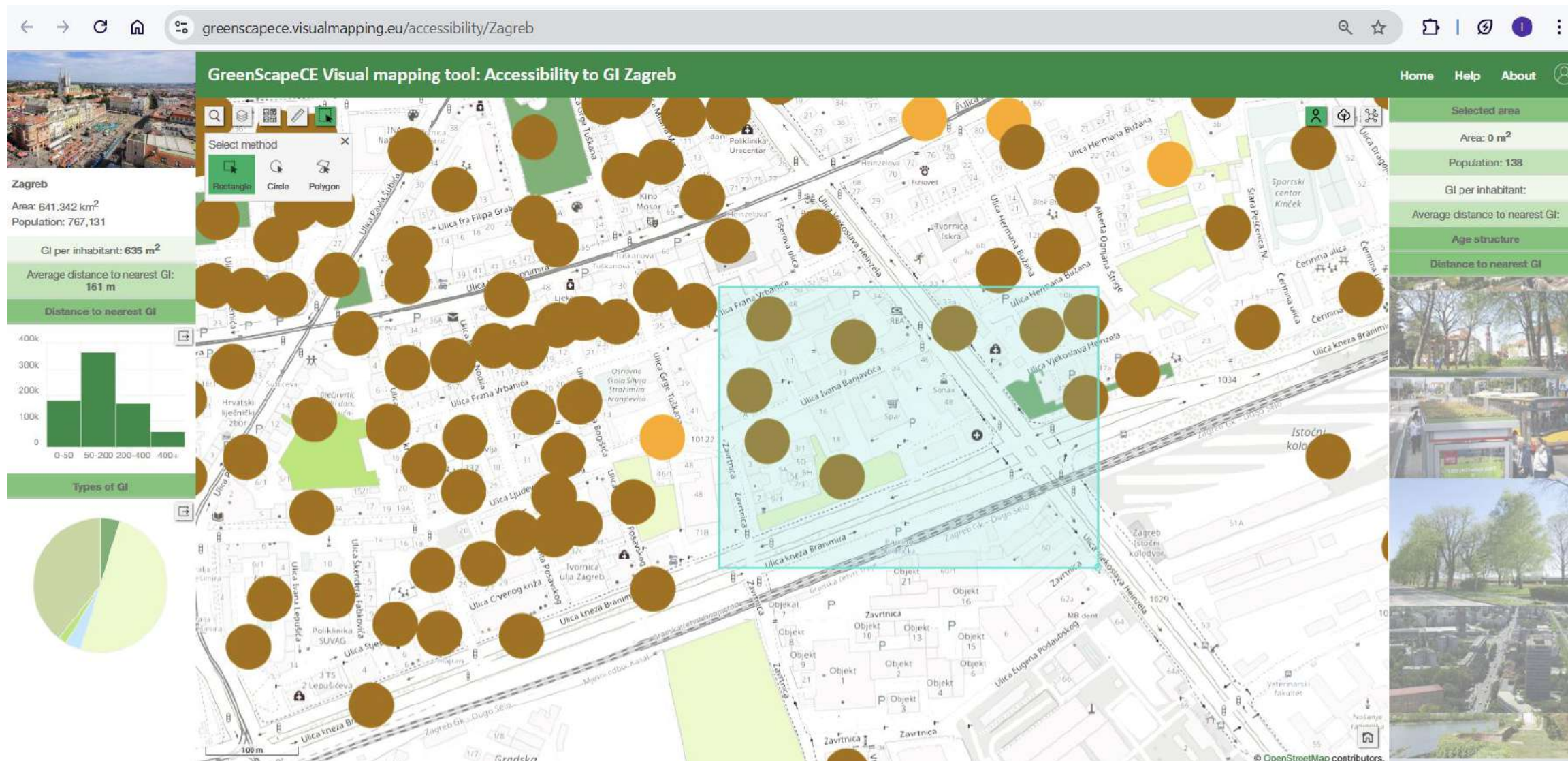
Map Area: The map shows a street grid of Zagreb with green dots representing green spaces. A scale bar indicates 500 m. The map is titled "GreenScapeCE Visual mapping tool: Accessibility to GI Zagreb".

The **Accessibility tool** calculates the population's accessibility to green spaces. The green spaces considered in the calculation of the accessibility indicator are those that are part of the green infrastructure, are walkable, and are publicly accessible.

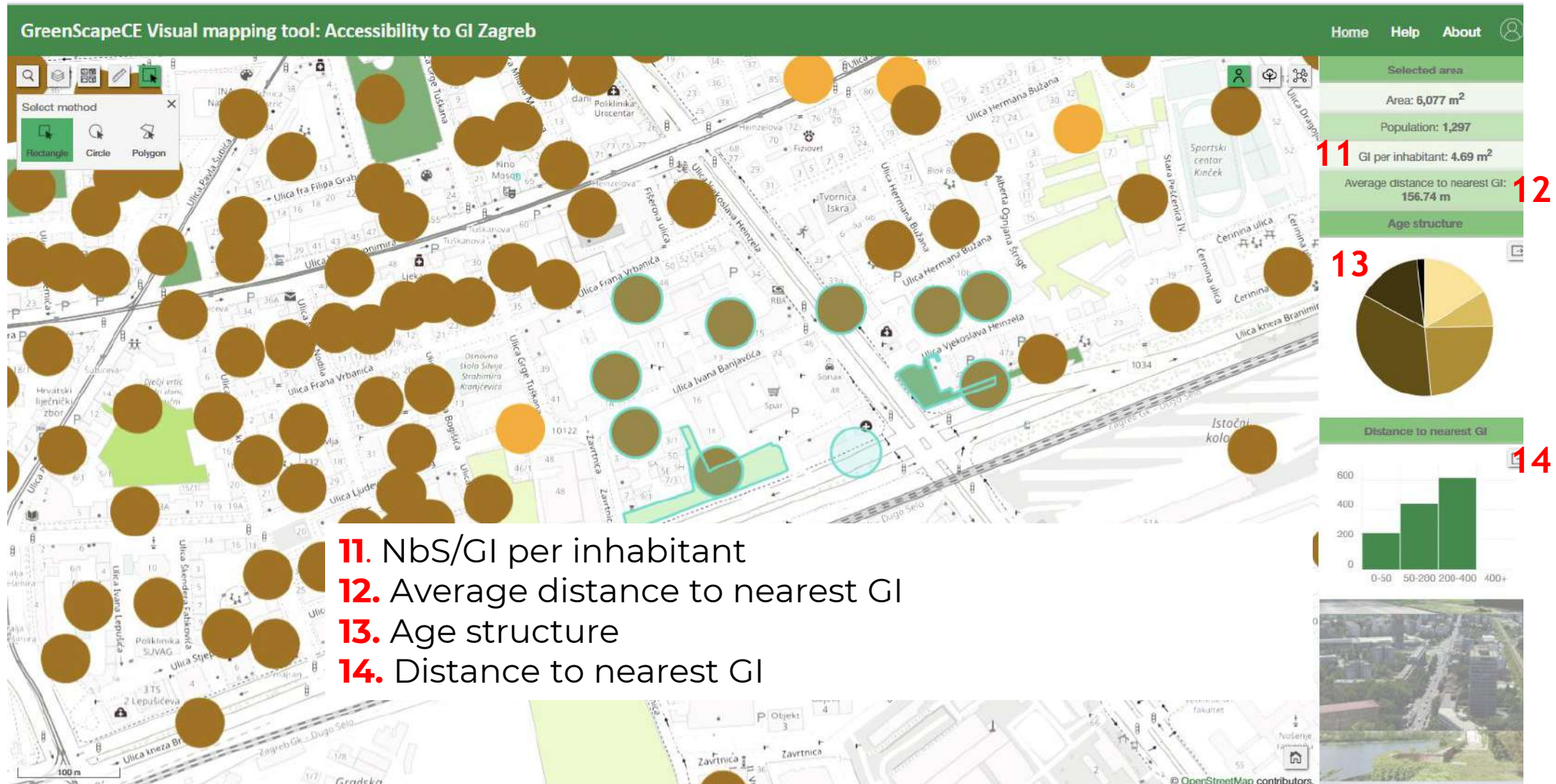


Accessibility

GreenScape CE



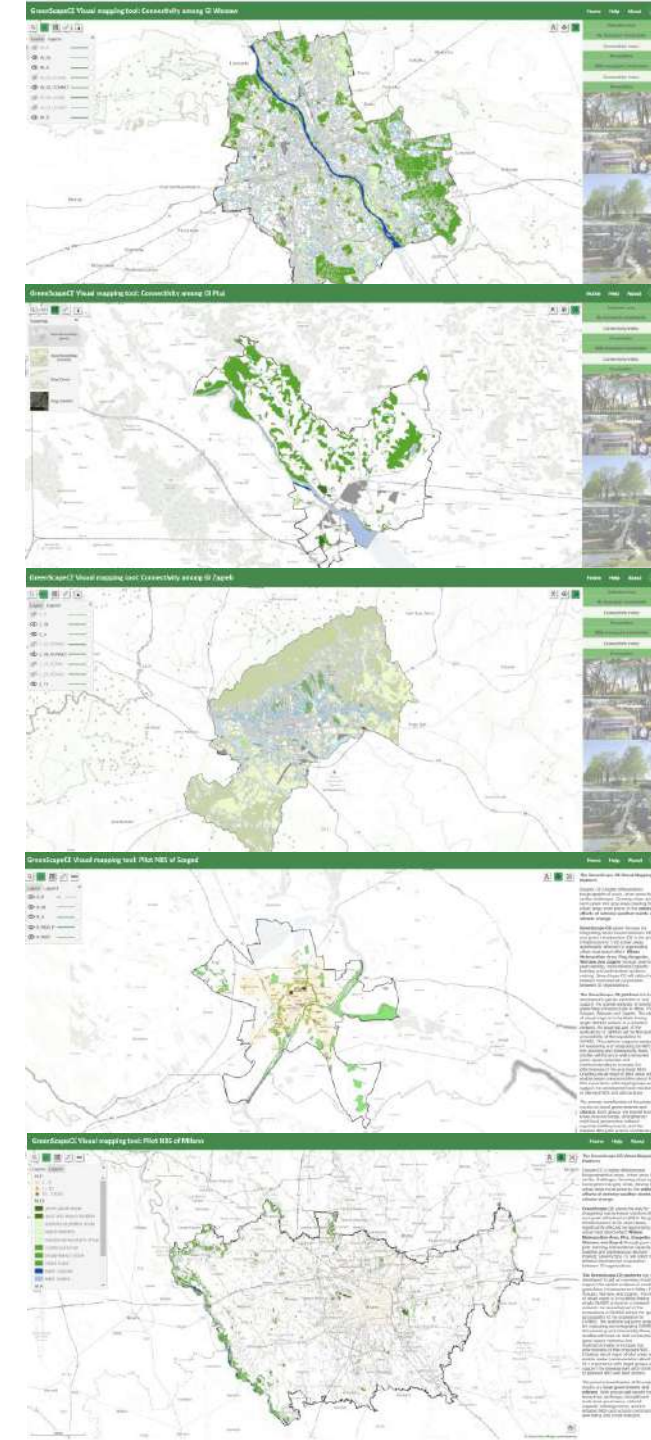
Accessibility



Connectivity tool

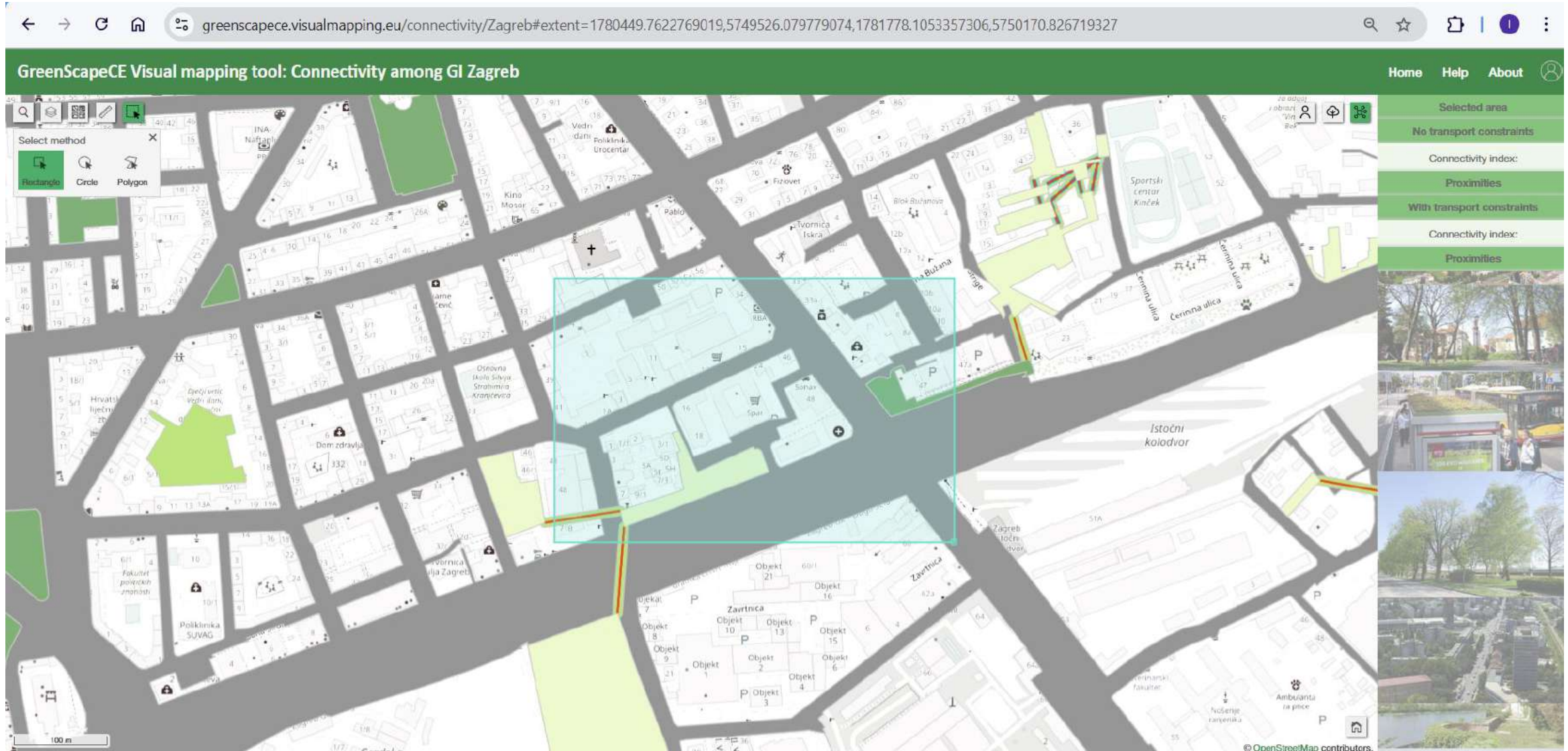


The **Connectivity tool** calculates the connectivity of green spaces within the selected area. The fragmentation of these spaces represents a significant issue in European cities. This tool is ideal for quickly measuring the connectivity of green spaces in a pilot area. It can be used to raise awareness and guide discussions on the potential of ecological corridors and biodiversity.



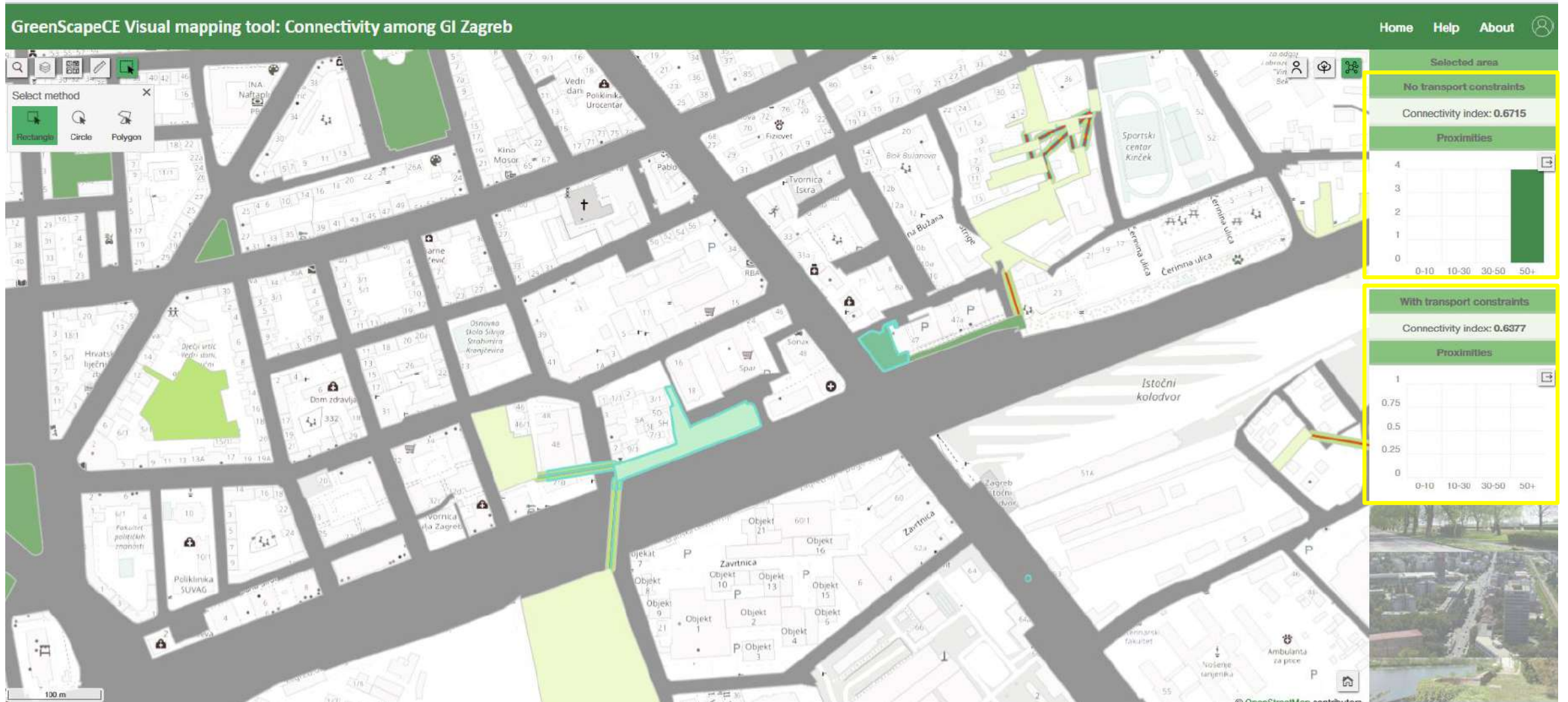
Connectivity tool

GreenScape CE



Connectivity index

GreenScape CE

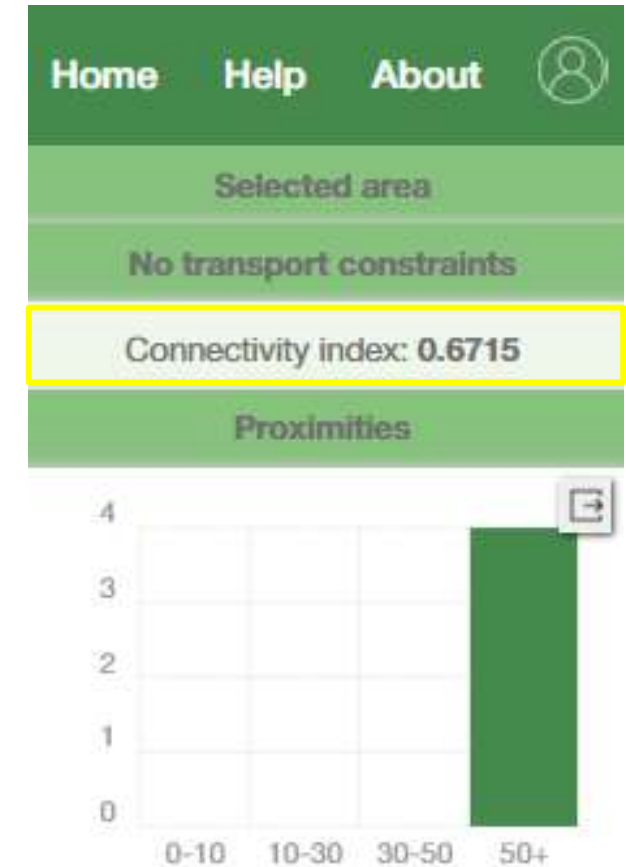


Connectivity index

The connectivity index measures how well green spaces are connected within a selected area. To calculate it, virtual connections are first identified between individual green spaces, considering only those located **less than 100 meters from each other**. These connected green spaces are then treated as “patches” of green space. Next, the index is calculated by summing the square of the areas of each green space patch, and then dividing this sum by the same operation performed for all green spaces in the area.

$$\text{index} = (\sum A_i^2) / (\sum A_i)^2$$

The index result ranges between **0 and 1**, where a higher value indicates that the green spaces are more interconnected within the selected area. The connectivity index can be calculated for any type of area, whether it is a rectangle, a circle, or a polygon.





Let's dive into the workshop 😊





UrbanGreenLeap

Interreg
Euro-MED



Co-funded by
the European Union

Thank you!

Iliriana Sejdullahu, Ambiente Italia srl.

Resear project manager

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