The role of the Urban Forest as an urban Carbon Sink

ABSTRACT

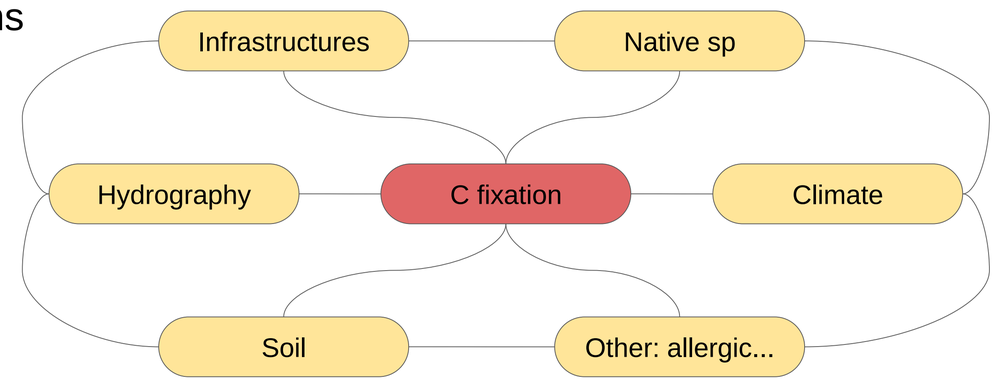
Key words

Urban Forest · CO_2 · Carbon sequestration · Carbon sink · Nature Based Solutions

Carbon (C) flows through ecosystems forming a cycle, not continuous, but it accumulates along them. There are processes that encourage the C accumulation on the atmosphere as a gas, which **Carbon Dioxide (CO_2)** is the most abundant and well-known its relation to the **greenhouse effect**. Plants can act removing atmospheric CO_2 throughout autotrophic processes and adding organic matter which is stored as their own biomass. As a result, the C keeps immobilized temporally within a process known as "**carbon sequestration**", a measurable effect by quantifying the total amount of **plants biomass.**

Cities can act as a C source increasing its release to the atmosphere as CO_2, from human activities related to combustion processes (traffic, industry and energy).

Urban Forests (UF) are proposed as a nature-based solution in urban areas due to its role as **carbon sink**, balancing part of this gas emissions. In order to achieve this effect, it is necessary to include specific criteria for **taxon selection** composition and typology of them during designing stage of UF. Likewise, it will be essential to take into account to establish a management plan (pruning, spacing, etc.).

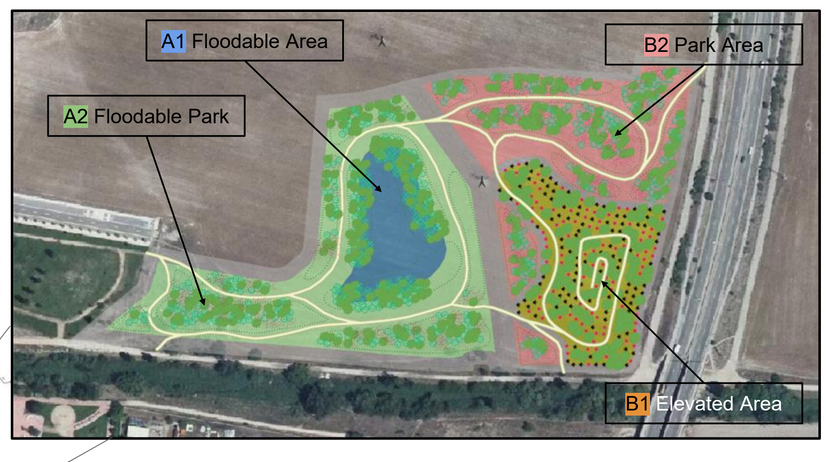


Multicriteria species assessment is required, focused on C fixation capacity, in addition with other aspects , such as native vegetation, easy management, aesthetics, health, ecological coherence and integrity criteria. Impacts derived from UF implementation must be evaluated on medium-long term, since to C fixation capacity of the species is highly related to the maturity grade of the taxons. Nowadays, UF are included in **NBS** categorization as a natural way to solve **climate challenges** in cities. **URBAN GreenUP** project incorporates an **UF** as a **Carbon Sink** whose aim is to reduce the CO_2 concentration in cities through the CO_2 fixing capacity of their biomass.

METHODOLOGY

Study area has been selected in an urbanizable parcel located at the Eastern entry of **Valladolid City (Spain)**, on the edge of Esgueva River.

The plot has been divided into **4 different areas**, based on the different ecological characteristics of each of them.



GIS software (QGIS) has been used in order to simulate an adequate distribution of trees, accomplishing two main criteria:

- ➔ **Minimum distance** between trees.
- ➔ **Aleatory** plantation **frame** in order to simulate natural stands.

Taking into account the particular zone conditions, a **list of indicative planting species** has been filled for each delimited area. An example is shown at the right for zone B1.

The taxa are classified by size. Thus, species 1 (**SP1**) groups taxa which exceed 15-20 m at maturity. Species 2 (**SP2**) are small trees that do not exceed 15-20 m in adulthood. Finally, species 3 (**SP3**) collects mainly bush-type taxa.

1. List of species proposed for Zone B1.
2. Estimated C fixation for main taxa.
3. An example of descriptive card for *Celtis australis*.

1

B1	[SP1]	[SP2]	[SP3]
❑ Elevated area ❑ Sloped ❑ No freatism ❑ Pollution ❑ Basic soils ❑ Clayey loam	Celtis australis Tilia sp Cupressus arizonica Ulmus minor Pinus halepensis	Ulmus pumila Colutea brevialata Ficus carica Quercus ilex subsp. ballota	Juniperus communis Quercus coccifera Osyris alba Retama sphaerocarpa

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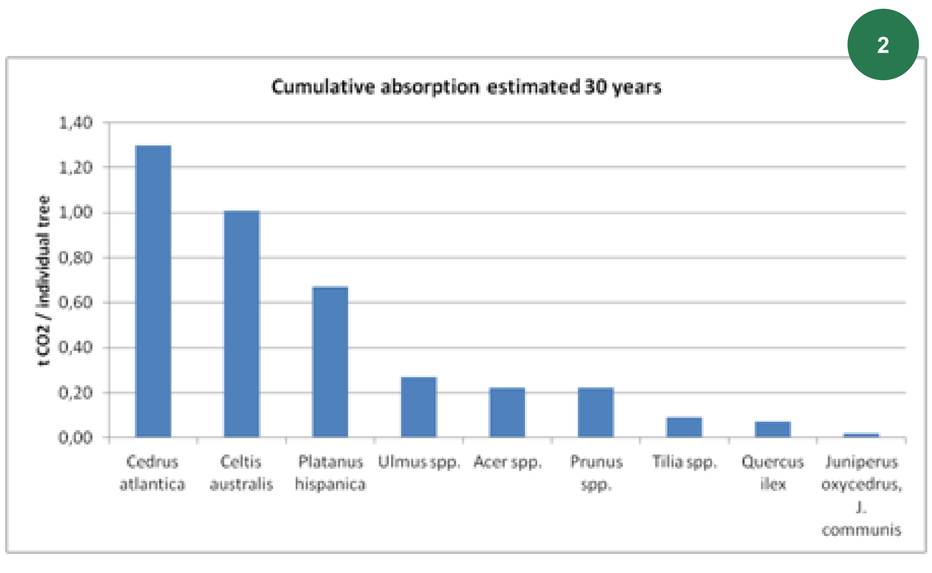
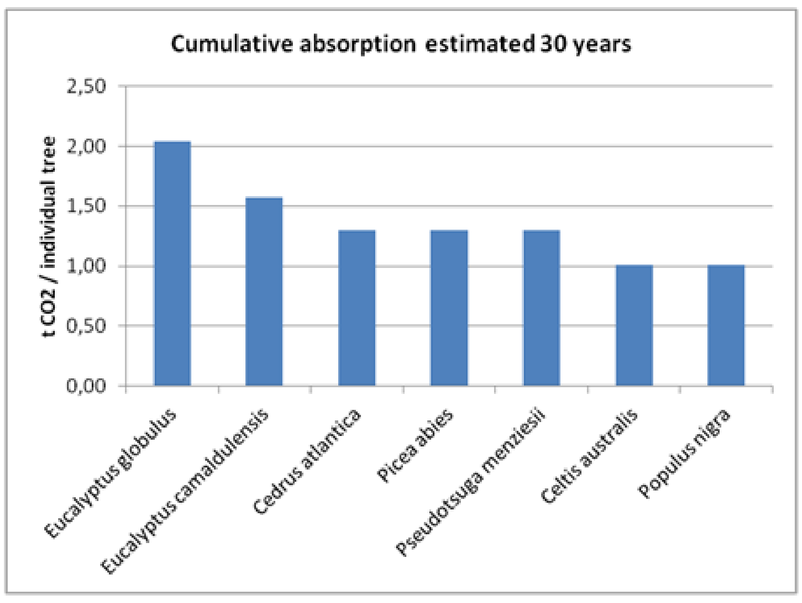


These three typologies should be combined and intermingled in each area conveniently within **small mixed forests** along the park.

SECTION	AREA	Description	Surface (m^2)	Number of trees	Density tree/ha
A Floodable Area	A1	Highly Depressed Area	4 510	241	534
	A2	Rest of the depressed area (park)	16 595	356	215
B Urban Carbon Sink	B1	Artificial hill	7 928	300	378
	B2	Rest of the Urban Carbon Sink (park)	12 129	403	332
TOTAL (T) / AVERAGE (A)			41 162 (T)	1300 (T)	316 (A)

Plants capture CO_2 in form of **biomass**, therefore, the **more growing** rate they have, the **more potential** capacity to fix **Carbon**. In this sense, species such as **poplars** or **eucalyptus** will sequester more carbon than those with slower growth such as yews or junipers.



The graphic on the left shows the most relevant forest species in **Mediterranean environments** that have the greatest capacity for carbon fixation. None of the top 5 species are native from Iberian Peninsula. The most relevant **native species** for C fixation are ***Celtis australis*** and **poplar**.

Source: Calculadora de Absorciones de CO_2 "Ex Ante" de las especies forestales arbóreas españolas. Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente del Gobierno de España

3

Species *Celtis australis*, L.

Native name Almez

Family *Cannabaceae*

Allergenic *Y* [_] - *N* [X]

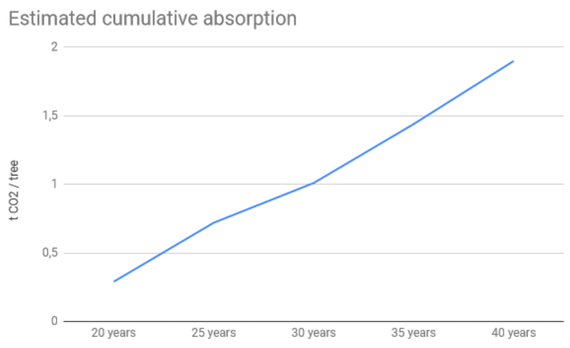
Taxonomy

Small deciduous tree up to 25 m high, with a thick trunk and straight smooth bark. Wide crown. Leaves simple, alternate, and lanceolate. Small flowers. Edible fruit round and smooth similar to a pea, firstly green and finally black.

Ecology and distribution

Mediterranean region. Soft and temperate climates, loose soils, tolerant to limestone. Pollution resistant.

C Absorption



Flowering and fruit maturity

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering												
Fruit maturity												

IMPACTS

Climate Change

Increase **C fixation** in urban areas throughout a **NBS** (Nature Based Solution)

Biodiversity and connectivity

Increase **biodiversity** and enhance of **ecological connectivity**.

Water & soil management

Decrease **run off** local effects avoiding **soil losses**.

Social

Promote **social knowledge** about **Urban Forest** and its **C fixation** effect.

Health & wellbeing

Enhance **health** and **wellbeing** of citizens by increasing the total surface of **green infrastructures.**

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