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PS 5.4 Changing benefits

Breathing in the Parks: an innovative tool to plan low-allergy urban forests in the future

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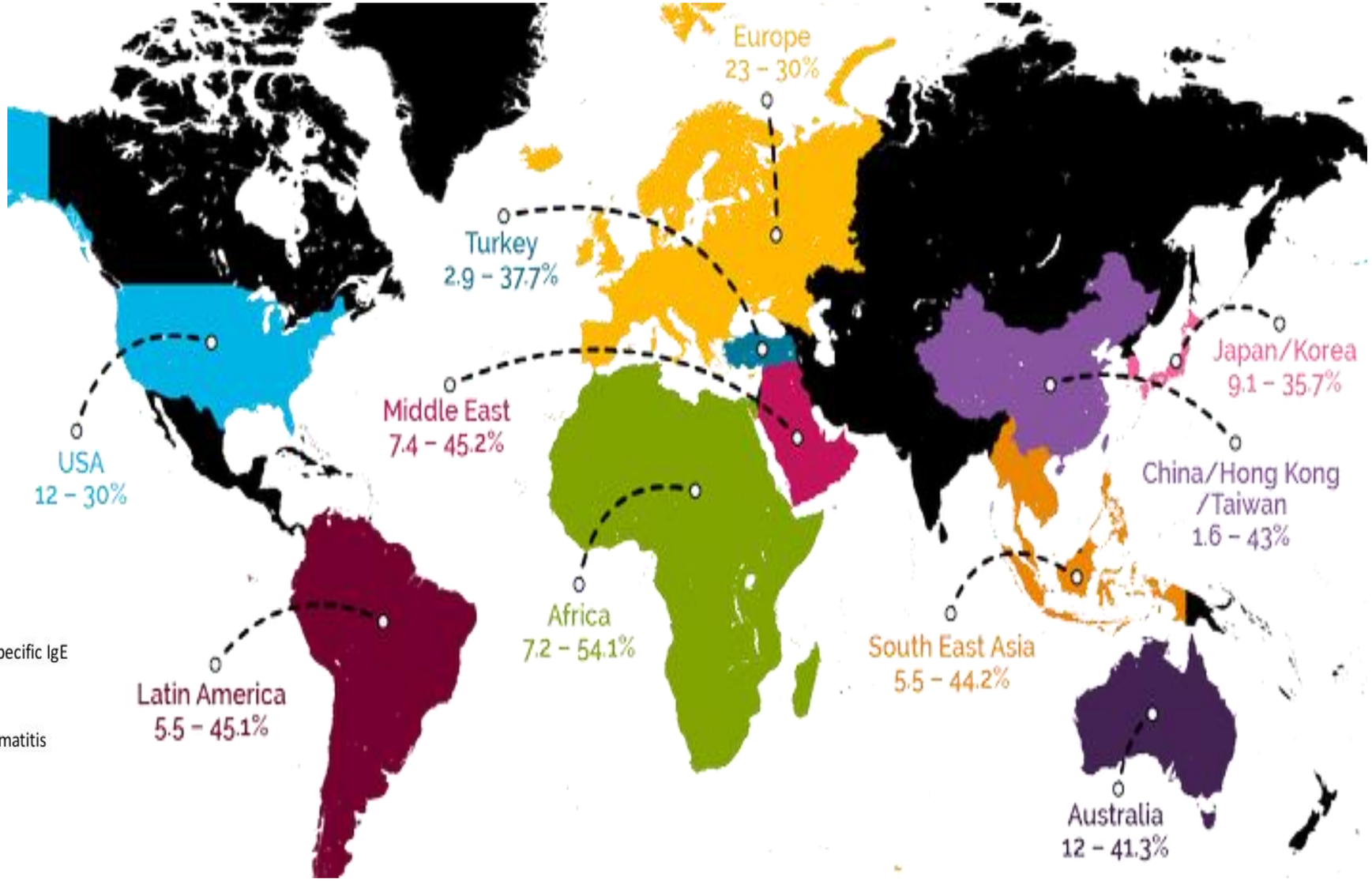
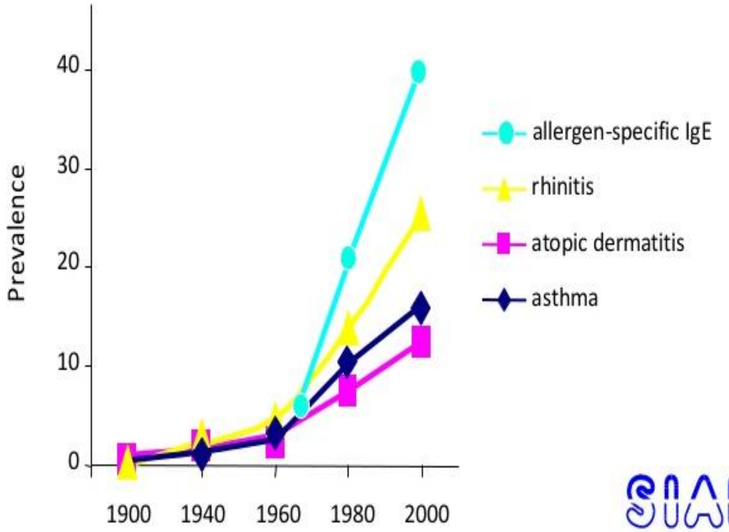
ALLERGY IS EPIDEMIC AROUND THE GLOBE





SIAF

Prevalence of allergic Rhinitis around the world (Tong & Lin, 2014)

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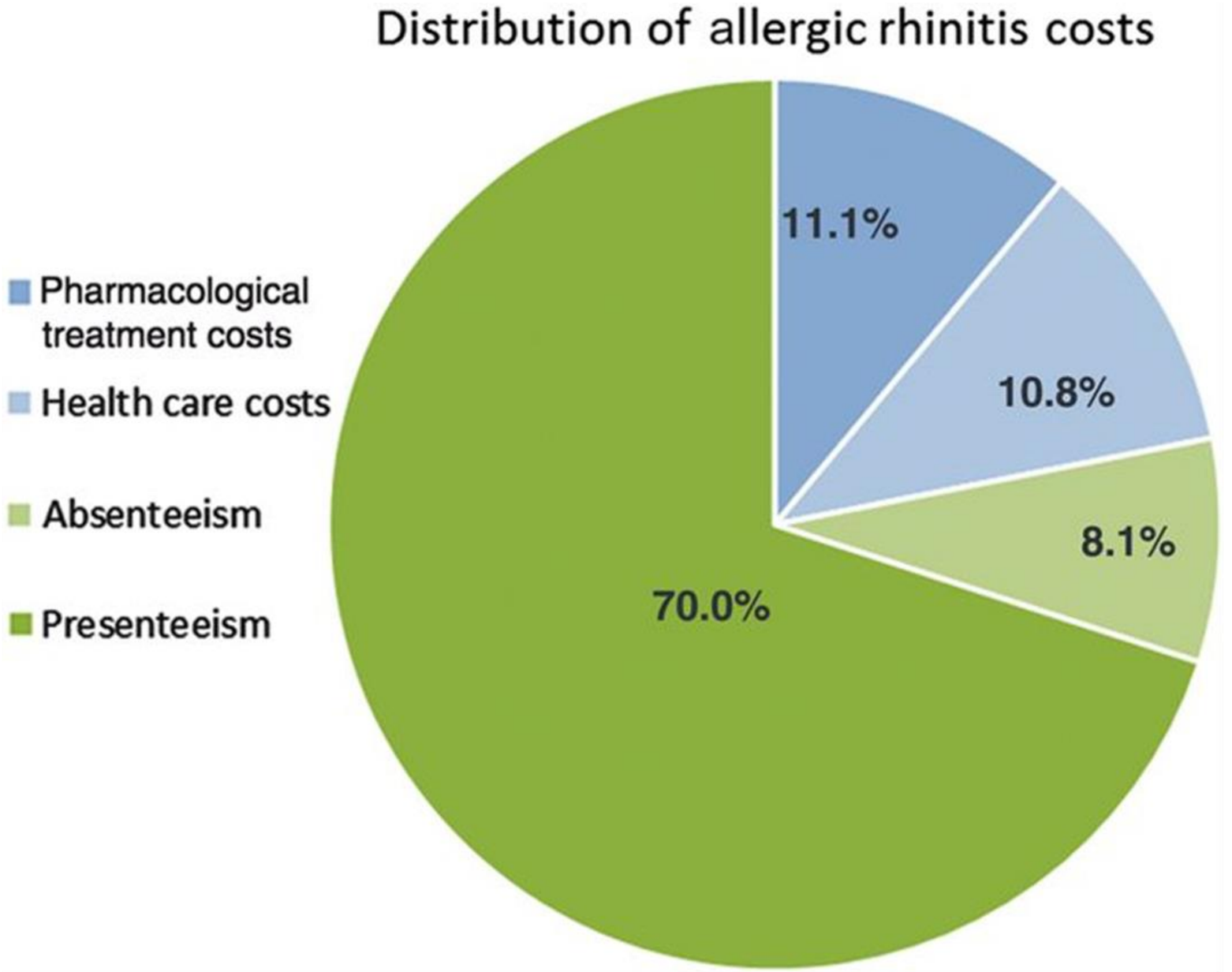

Total cost/individual with allergic rhinitis/year: €961.1

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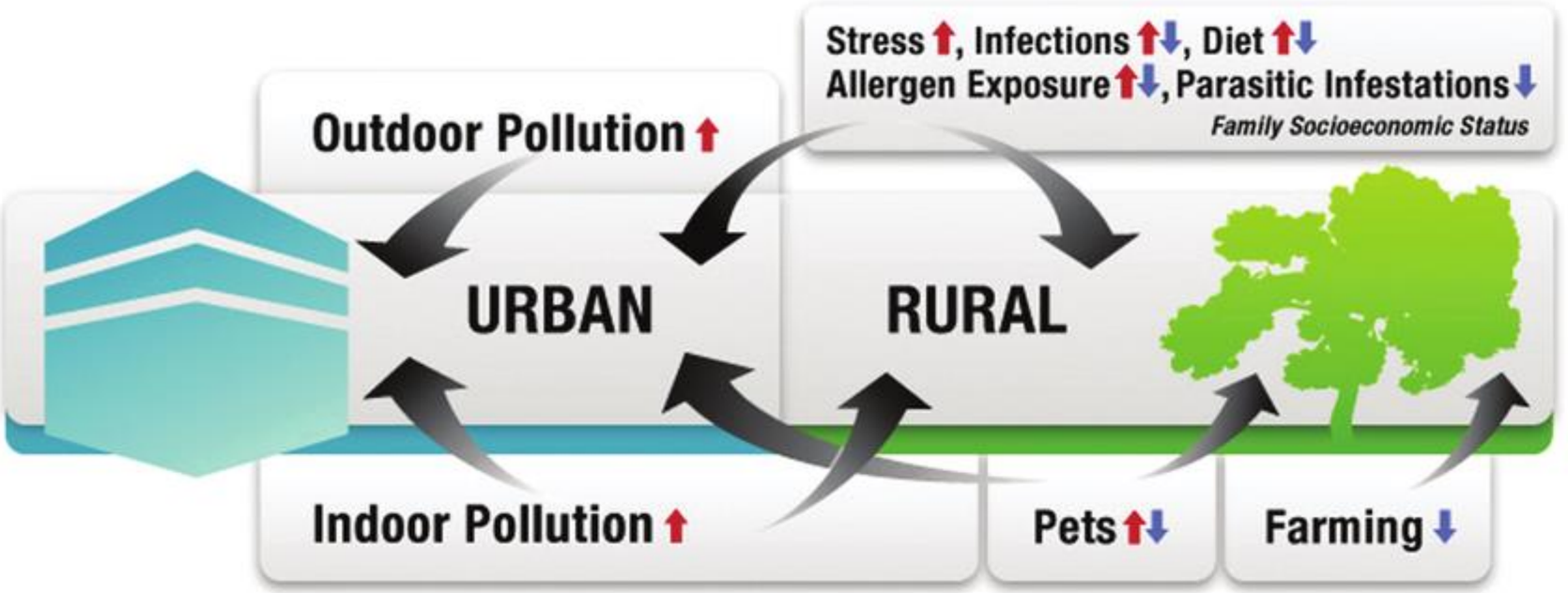
URBAN ALLERGY VERSUS RURAL ALLERGY



- MAJOR INCIDENCE OF ALLERGY IN URBAN THAN IN RURAL AREAS
- SOME OF THE MOST FREQUENT TREE SPECIES GROWING IN URBAN GREEN AREAS ARE INVOLVED IN ALLERGIC REACTIONS.

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CAUSES OF GROWING ALLERGENICITY OF URBAN FORESTS

- USE MASSIVE OF LOW NUMBER OF SPECIES-LOW BIODIVERSITY
- FORMATION OF GREAT SOURCES OF POLLEN EMISSIONS
- BOTANICAL SEXISM
- INTRODUCTION OF ALLOCHTHONOUS SPECIES
- INVASIVE SPECIES
- LOW MANAGEMENT AND MAINTENANCE
- ESTABLISHMENT OF CROSS-REACTIONS
- PROXIMITY ALLERGY
- INTERACTION WITH POLLUTANTS
- CLIMATE CHANGE

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Review

Urban green zones and related pollen allergy: A review. Some guidelines for designing spaces with low allergy impact

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ABSTRACT

Urban green spaces are a key element in the planning of today's cities, since they favor the interaction between citizens and the environment, as well as promoting human health. However, lack of planning in the design of urban spaces and in the choice of ornamental species has been among the factors triggering one of the most widespread diseases in urban populations: pollen allergy. In this paper are reviewed the major causes of this extensive allergenicity, including: low species biodiversity at planting; the over-abundance of given species acting as key specific pollen sources; the planting of exotic species prompting new allergies in the population; the choice of male, pollen-producing individuals in dioecious species; the presence of invasive species; inappropriate garden management and maintenance activities; the appearance of cross-reactivity between phylogenetically related species; and the interaction between pollen and air pollutants. The findings of this analysis highlight the clear need for guidelines regarding the design and planning of urban green spaces with a low allergy impact. Proposals include increased biodiversity, careful control when planting exotic species, the use of low pollen producing species, the adoption of appropriate management and maintenance strategies, and active consultation with botanists when selecting the most suitable species for a given green space.

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BREATHING IN THE PARKS

AN INITIATIVE TO ESTIMATE ALLERGENICITY OF URBAN FOREST AND DESIGN GREEN SPACES OF LOW ALLERGEN IMPACT

GUIDELINES

TOOLS

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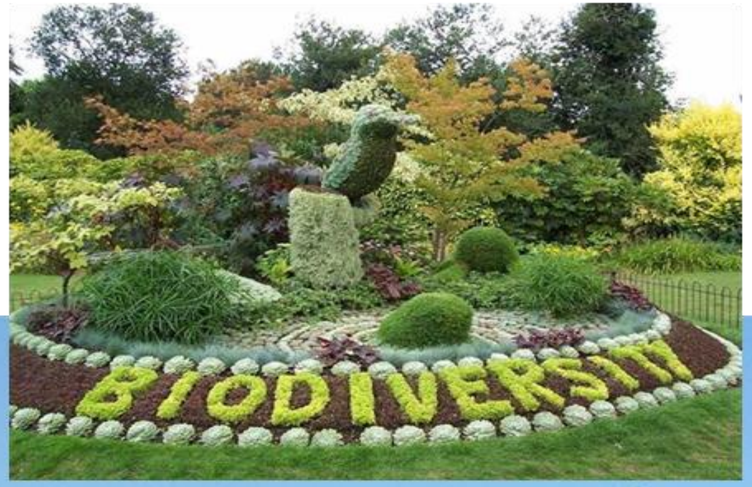
GUIDELINES

INCREASE BIODIVERSITY



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GUIDELINES

AVOIDING FORMATION OF LARGE EMISSIONS SOURCES

The replacement of a third of the trees in a monospecific alignment reduces pollen emissions by 30%

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GUIDELINES

PROMOTE GENDER BALANCE

Morus nigra, Schinus molle, P. alba "pyramidalis", P. nigra "Gigantea", Acer campestre, Zelkova serrata, Fraxinus ornus.

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GUIDELINES

CONSIDERATION OF THE CRITERION OF ALLERGENICITY AT THE TIME OF INTRODUCING PLANT MATERIAL IN THE LANDSCAPE

Aesthetic considerations for plant selection include:

- growth habit, i.e. pyramidal, columnar, spreading, etc.
- season and color of bloom
- foliage color, texture, and shape
- winter interest of bark, fruit, or structure
- benefits to wildlife
- fall color
- Longevity
- **ALLERGENICITY???**

Some site conditions to keep in mind when selecting landscape plants include:

- light availability, intensity and duration (full sun to deep shade)
- water availability, both quantity and quality
- exposure to wind and temperature extremes
- soil type, drainage, compaction
- hardiness zone
- competition from existing vegetation
- below ground conditions in urban sites
- above ground wires or obstructions

"Right Plant, Right Place" - A Plant Selection Guide for Managed Landscapes

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TOOLS

- **ASSIGNMENT OF AN ALLERGEN POTENTIAL VALUE (VPA) TO URBAN TREES**

- **APPLICATION OF THE ALLERGENICITY INDEX OF URBAN GREEN SPACES (I_{UGZA})**

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OBTENTION OF VALUE OF POTENTIAL ALLERGENICITY
VPA: TP X DPP X AP

TYPE OF POLLINATION (TP)

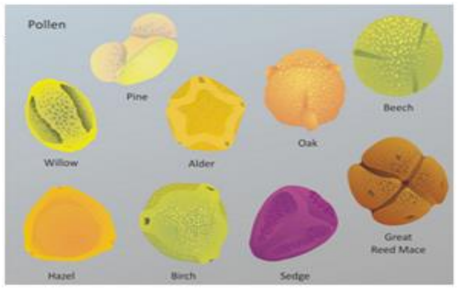


- Value 0: Plants that do not emit pollen because they are sterile (varieties, hybrids, cultivars), cleistogames or are just female sex.
- Value 1: Plants of primarily or exclusively biotic pollination, with low pollen emission.
- Value 2: Mixed pollination system plants (ambiphillic), without any of them prevails and moderate-high pollen emission.
- Value 3: Wind pollinated plant species which produce and release large amounts of pollen.

DURATION OF POLLINATION PERIOD (DPP)

- Value 1: when pollen emissions last 1 to 3 weeks
- Value 2: when pollen emissions last 4 to 6 weeks
- Value 3: when pollen emissions last more than 6 weeks or all the Genus/species share the same pollen type and pollination occurs successively.

ALLERGENIC POTENTIAL (AP)



- Value 0: non-allergenic or without reference as allergenic.
- Value 1: low allergenicity
- Value 2: moderate allergenicity, with moderate incidence on population
- Value 3: high allergenicity, with high incidence on population.
- Value 4: major allergens in the Mediterranean region, broad distribution and presence, very high incidence on population.

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PLANTS ATTRIBUTES THAT INCREASE ALLERGENICITY

SPECIES	ATRIBUTES	ORIGIN	HARDINESS ZONE	ALLERGENICITY
Acer campestre	D-I-DE	Eur.As.Afr.	6a-6b	Moderate
Acer pseudoplatanus	H-I-DE	Eur.As.Afr.	4b	Moderate
Acer negundo	D-W-DE	N-Am.	4b	High
Celtis australis	M-W-DE	Eur (Med).	5b	Moderate
Cupressus sempervirens	M-W-EV	Eur (Med).	8b	Very High
Fraxinus excelsior	D-W-DE	Eur (Med).	4b-5a	High
Fraxinus angustifolia	D-W-DE	Eur (Med).	6b-7b	Moderate
Ligustrum lucidum	H-A-EV	China	8a-11b	Moderate
Magnolia spp.	H-I-EV	N-Am.China	6b-8a	Low
Pinus halepensis	M-W-EV	Eur (Med).	8a-9b	Low
Pinus pinea	M-W-EV	Eur (Med).	6b	Low
Pinus pinaster	M-W-EV	Eur (Med).	8a	Low
Platanus x hispanica	M-W-DE	Eur.	6b	Very High
Populus alba	D-W-DE	Eur.As.Afr.	4b	High
Quercus ilex	M-A-EV	Eur (Med).	5b-7b	Moderate
Robinia pseudoacacia	H-I-DE	N-Am.	4b-5a	Low
Taxus baccata	D-W-EV	Eur.	5a-5b	High
Tilia cordata	H-A-DE	Eur.	5a	Low
Tilia platyphillos	H-A-DE	Eur. As.	5a	Low
Ulmus minor	D-A-D	Eur. N-Am. As.	6b	High

Cariñanos et al., 2018. **Quantifying allergenic potential of urban trees and urban parks in the Mediterranean region. IJERPH.** In press

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INDEX OF ALLERGENICITY OF URBAN GREEN ZONES (I_{UGZA})

$$I_{UGZA} = \frac{1}{maxVPAxS_T} \sum_{i=1}^{k} VPA \times S_i \times Hi$$

Where:
K= number of species in the park
maxVPA= maximum value of potential allergenicity
Si= surface of each species
ST= surface of green space
Hi= maximum height of the species

Cariñanos P, Casares-Porcel M, Quesada-Rubio JM. 2014. Estimating the Allergenic potential of Urban Green Zones: A case-study in Granada, Spain. Landscape and Urban Plannnig, 123:134-144.

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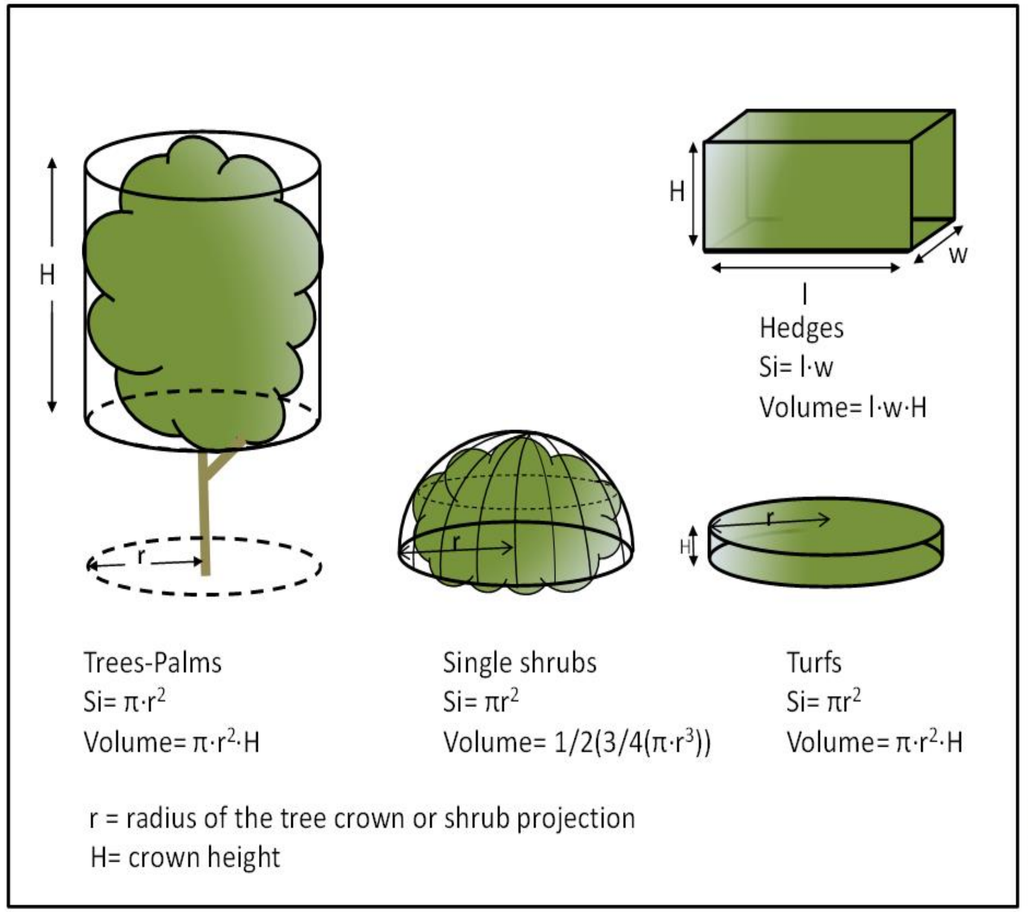
BIOMETRIC PARAMETERS

CROWN DIAMETER, CROWN HEIGHT

1-3 m

4-6 m

>6 m



Trees-Palms
Si= $\pi \cdot r^2$
Volume= $\pi \cdot r^2 \cdot H$

Hedges
Si= $l \cdot w$
Volume= $l \cdot w \cdot H$

Single shrubs
Si= πr^2
Volume= $1/2(3/4(\pi \cdot r^3))$

Turfs
Si= πr^2
Volume= $\pi \cdot r^2 \cdot H$

r = radius of the tree crown or shrub projection
H= crown height

Cariñanos P et al., 2014. Estimating the Allergenic potential of urban green zones: A case-study in Granada, Spain. Landscape and Urban Planning

0,25 m

0,75- 1,5 m

2, 4, 6, 8, 10, 12, 14, 16,.....m

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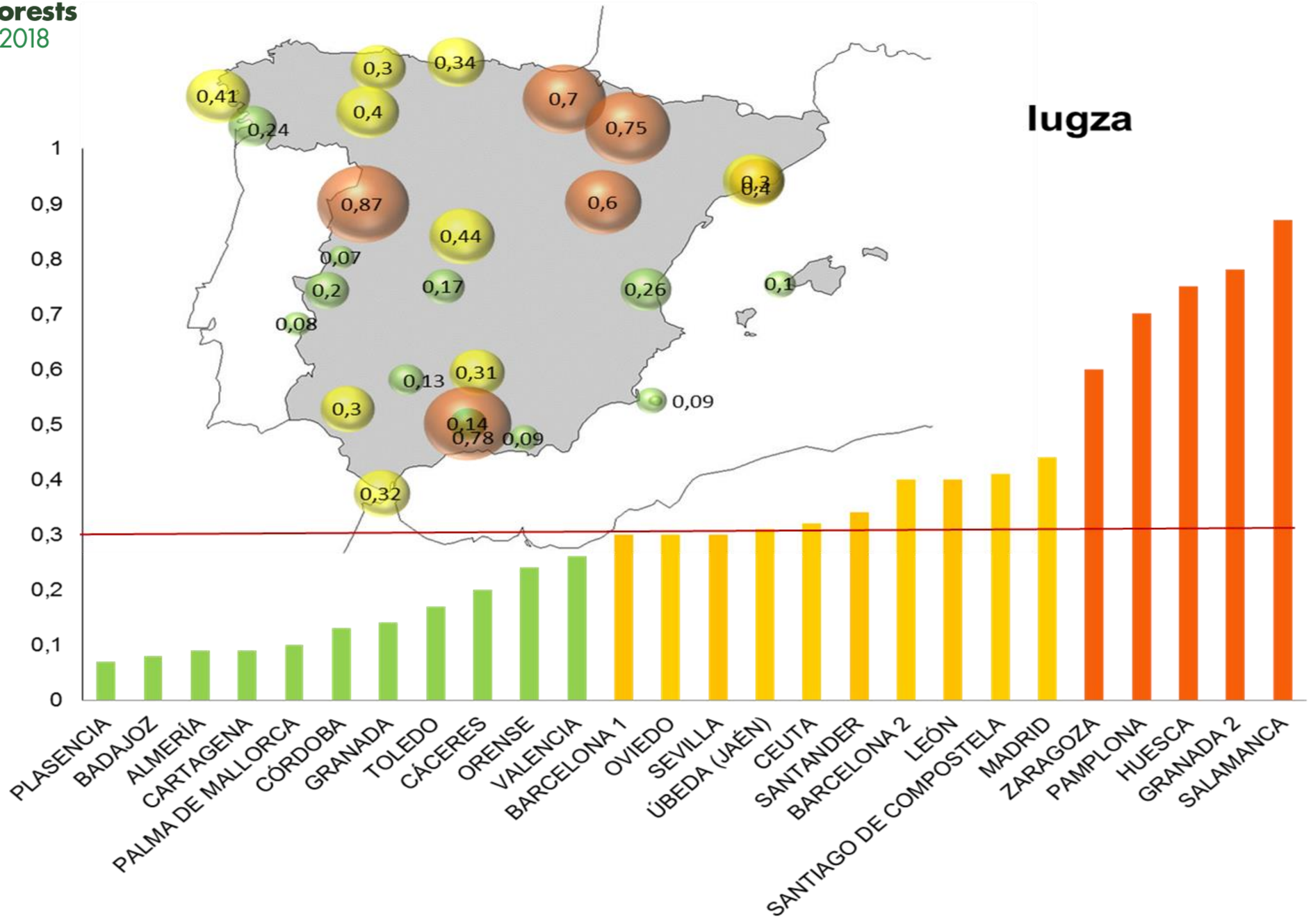
IUGZA OF 26 SPANISH URBAN PARKS



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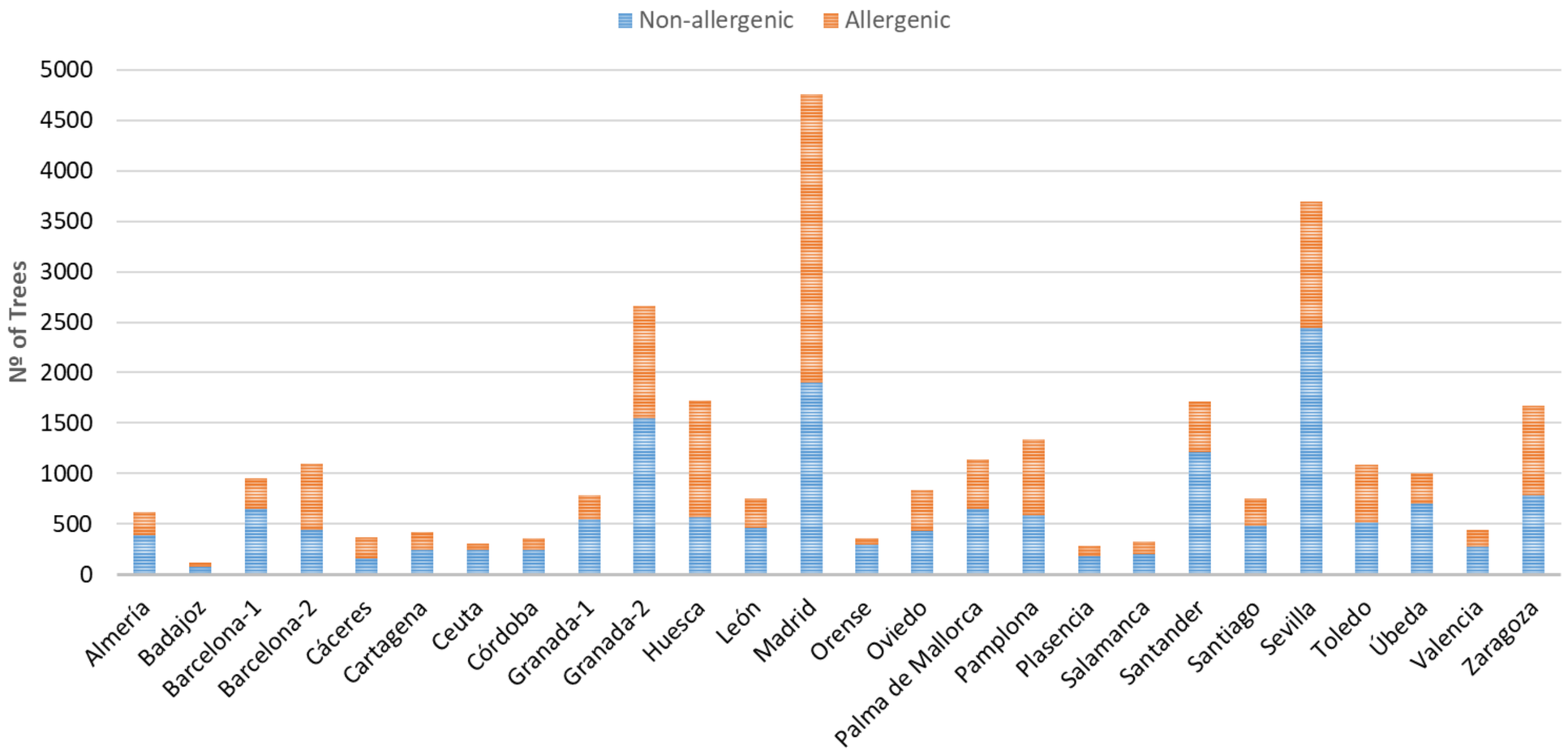
WHAT INFORMATION CAN BE OBTAINED FROM IUGZA?

RATIO ALLERGENIC-NON ALLERGENIC TREES



Cariñanos et al., 2017. Assessing allergenicity in urban parks: A nature-based solution to reduce the impact on public health. Environmental Research, 155:219-22

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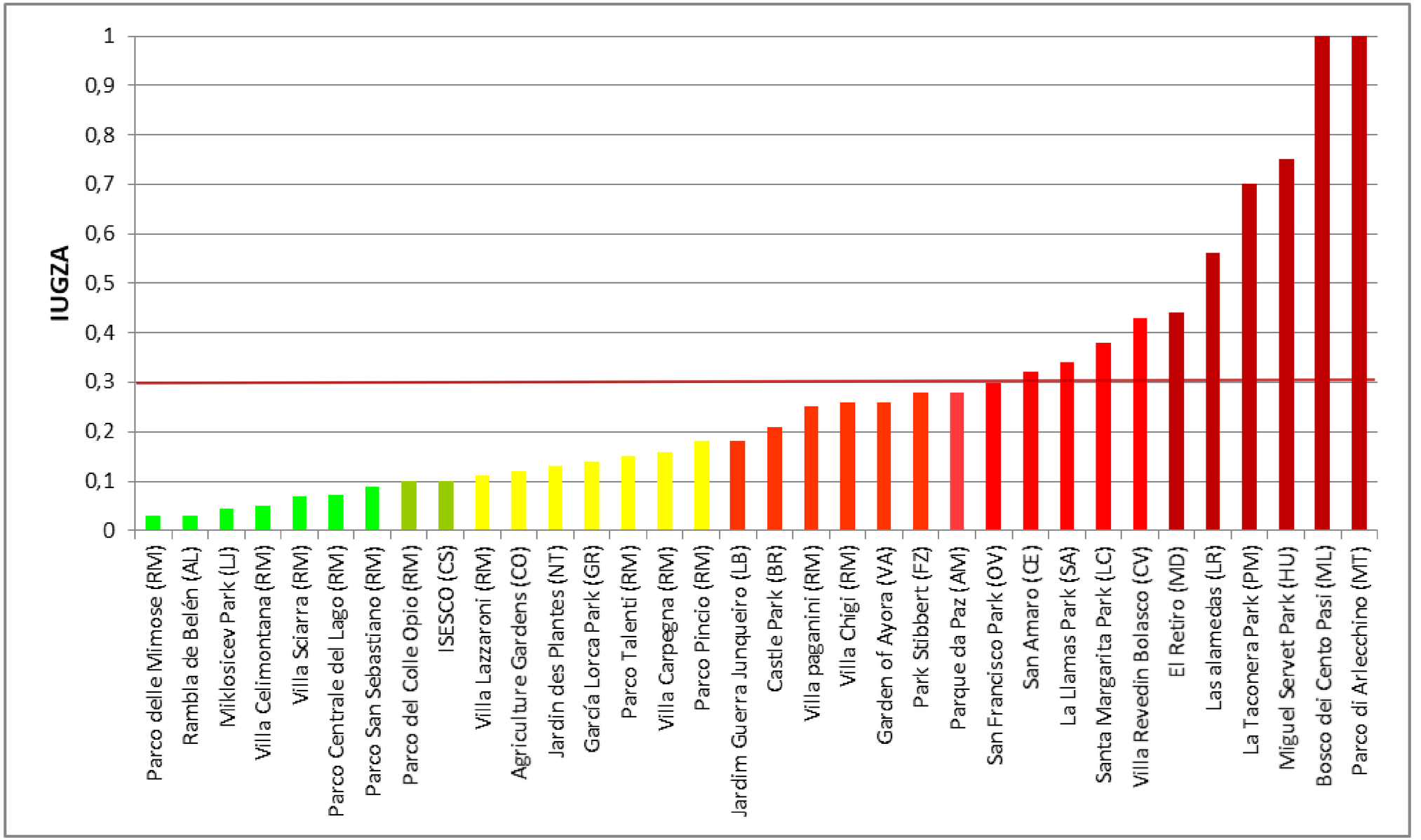
IUGZA OF 34 MEDITERRANEAN URBAN PARKS



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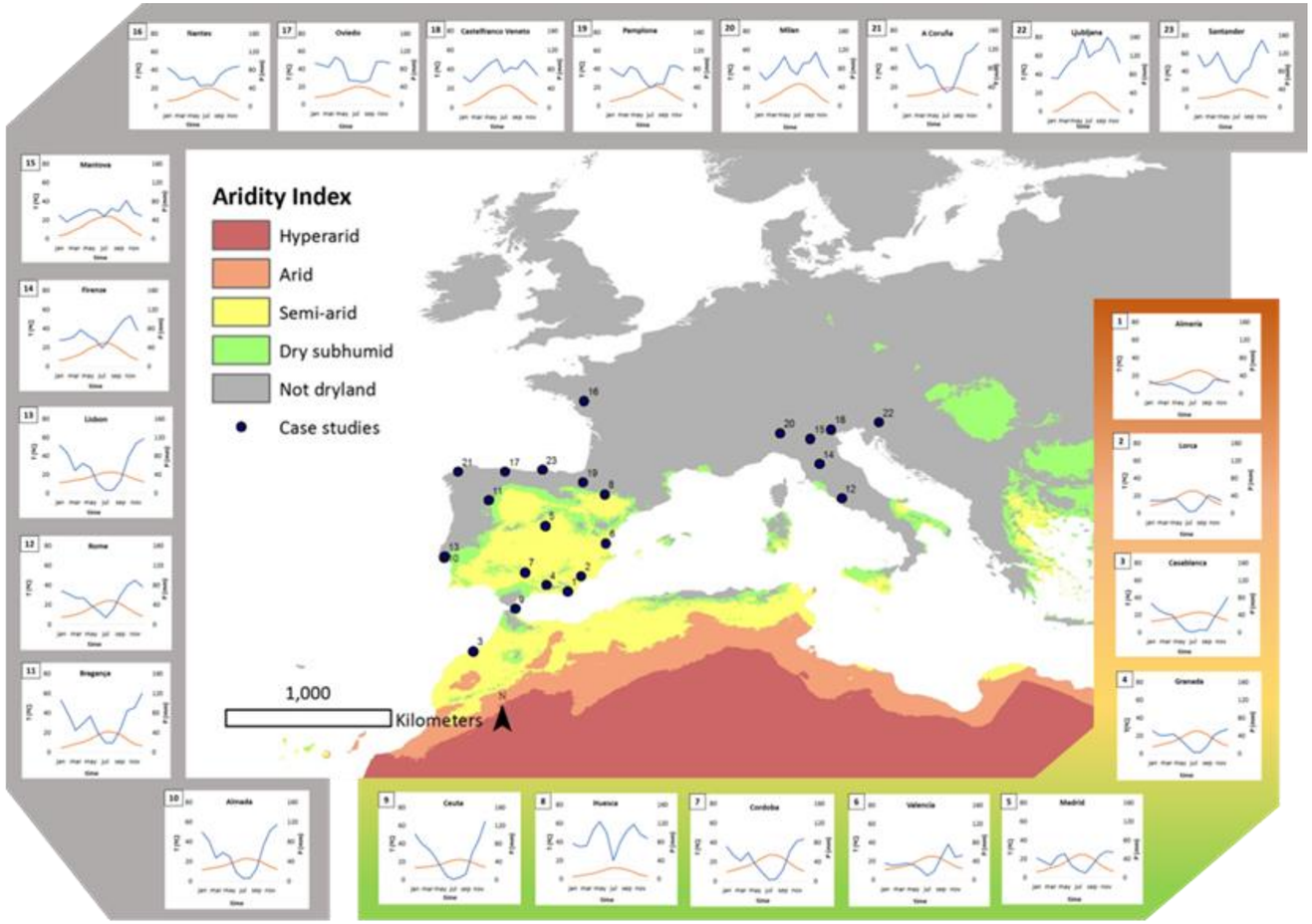
WHAT INFORMATION CAN BE OBTAINED FROM IUGZA?

THE BIOCLIMATIC CHARACTERISTICS THAT MOST INFLUENCE ON THE IUGZA

Variable	R
BIO9	-0,38*
BIO1	-0,35*
Temperature of August	-0,34*
BIO18	0,35*
Precipitation of July	0,38*
Precipitation of May	0,43*
Shannon index	0,45**
Number of species	0,54**
Number of trees	0,65**
Tree density (ha)	0,70**



Tested Bioclimatic Variables: annual mean temperature (**BIO1**), mean diurnal range (**BIO2**), isothermality (**BIO3**), temperature seasonality (**BIO4**), maximum temperature of the warmest month (**BIO5**), minimum temperature of the coldest month (**BIO6**), annual temperature range (**BIO7**), mean temperature of the wettest quarter (**BIO8**), mean temperature of the driest quarter (**BIO9**), mean temperature of the warmest quarter (**BIO10**), mean temperature of the coldest quarter (**BIO11**), annual precipitation (**BIO12**), precipitation of the wettest month (**BIO13**), precipitation of the driest month (**BIO14**), seasonality precipitation (**BIO15**), precipitation of the wettest quarter (**BIO16**), precipitation of the driest quarter (**BIO17**), precipitation of the warmest quarter (**BIO18**), and precipitation of the coldest quarter (**BIO19**).

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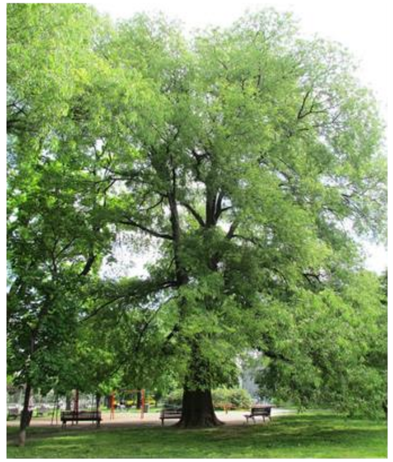
LIST OF MOST COMMON SPECIES (at least in 50% of the parks)

*Acer campestre*** Eu.As.Af.
*Acer pseudoplatanus*** Eu.As.Af
*Acer negundo**** N. Am
*Celtis australis*** Eu(Med)
*Cupressus sempervirens***** Eu(Med)
*Fraxinus excelsior*** Eu(Med)
*F. angustifolia***Eu(Med)
*Ligustrum lucidum*** Ch.
*Magnolia spp.** N.Am, Ch.
*Pinus spp.** Eu(Med)
*Platanus x hispánica*****Eu(Spain)
*Populus alba****Eu.As.Af
*Robinia pseudoacacia** N.Am
*Taxus baccata****Eu.
*Tilia cordata**Eu.
*Tilia platyphillos**Eu.As.
*Ulmus minor****Eu.N.Am.As.
*Quercus ilex***Eu(Med)

** Low Allerg ** Mod Allerg *** High Aller **** Major Allerg*

INVENTORY OF TREES

Box elder



Hackberry

Cypress

London plane

Lime, linden

Ash

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WHAT INFORMATION CAN BE OBTAINED FROM IUGZA?

THE DESIGN AND CHARACTERISTICS OF URBAN FORESTS THAT MOST INFLUENCE THE ALLERGENICITY OF THE SPACE

NAME OF PARK, LOCALITY (TYPE)	No OF TREES (% ALLERGENIC TREES)	(TREES/Ha.)	SPECIES RICHNESS	IUGZA	COMMENTS
BOSCO DEI CENTO PASI, MILANO (COMMUNITY PARK)	7,710 (42.59%)	771	15	>1	Low diversity,, High presence of allergenic species, High density of trees
PARCO DI ARLECCHINO BIGARELLO (MANTOVA) (DISTRICT PARK)	8,157 (71.44%)	562,55	58	>1	High diversity, High presence of allergenic species, High density of trees
SANTA MARGARITA LA CORUÑA, SPAIN (COMMUNITY PARK)	1,056 (62.11%)	120,68	59	0,38	High Diversity, High number of individuals of allergenic species, Moderate density of trees
MIGUEL SERVET PARK HUESCA, SPAIN (URBAN FOREST)	1,725 (57.95%)	265,38	30	0,75	Moderate Diversity, High percentage of allergenic species, High density of trees




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CONCLUSIONS

THE BREATHING IN THE PARKS INITIATIVE WILL HELP THE FRIENDLY, HYPO-ALLERGENIC, HEALTHY AND BREATHABLE URBAN FORESTS BECOME A REALITY IN THE FUTURE

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