Session 3.5

The Day of the Triffids: How to manage risks associated with urban forests (invasive species, allergies, fires, breakages, falls)

Chair: Pete Smith

World Forum on Urban Forests

2nd World Forum on Urban Forests

Washington DC, 2023

Public policy for management of forest pests within an ownership mosaic

Presented by

Andrew R. Tilman, PhD

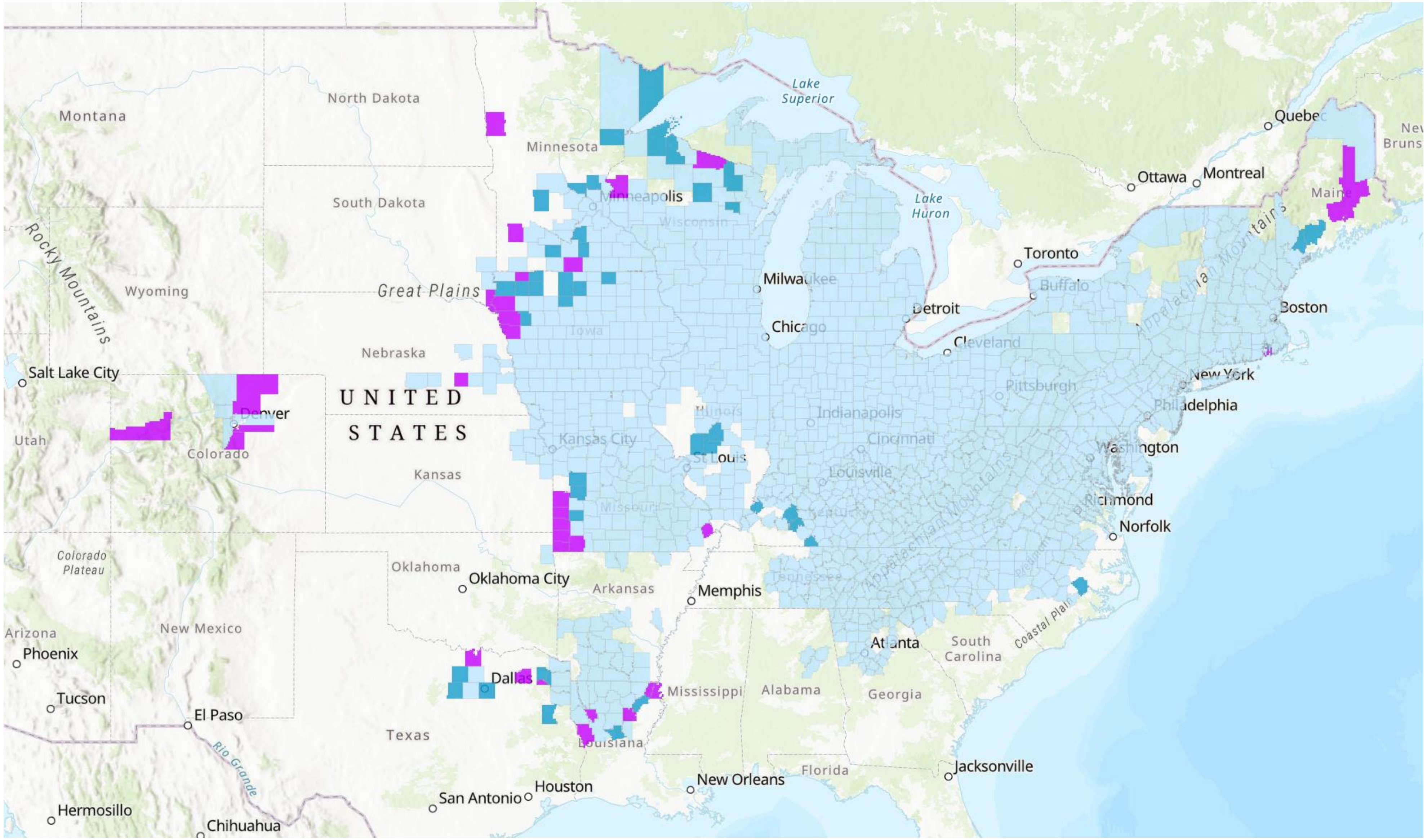
Research Economist

USDA Forest Service, Northern Research Station

Emerald Ash Borer:
A threat to urban forests

Pictures from: USDA APHIS | Emerald Ash Borer and Knight et. al., 20

Known infested counties



- 2002 - 2021
- 2022
- 2023

[Emerald Ash Borer (EAB) Known Infested Counties] USDA APHIS

Estimated costs of ash removal and property value loss ($ billion)

Government	Homeowners	
Removal	Removal	Property loss
$8.5	$3.5	$3.8

Kovacs et al. - Cost of potential emerald ash borer damage in U.S. communities, 2009–2019 – *Ecological Economics*

EAB management strategies

	Community forest infestation status		
Strategy	**Not infested**	**Generally infested**	**Heavily infested**
Planning			
Inventory			
Monitoring			
Treatment			
Removal			
Wood utilization			
Replanting			
Biological			

	Good time to utilize this tactic
	Getting late to utilize this tactic
	Last chance before opportunity is lost
	Not appropriate tactic at this time

Minnesota Emerald Ash Borer Management Guidelines 2018 (state.mn.us)

Tree photo from: Knight et. al., 2014

- Cooling

Stormwater management

Carbon sequestration

Hennepin County property map

City Of Burnsville

How can we help you?

Select Language

- Emerald Ash Borer FAQ
- How to Identify an EAB Infestation
- Boulevard Ash Updates

Home › City Services › Natural Resources › Forestry › Emerald Ash Borer

EMERALD ASH BORER

Property Owners Encouraged to Take Action Now

OPTION 1: Removal

OPTION 2: Pesticide Treatment

Discounted Treatment Pricing

Images From: [Emerald Ash Borer | Burnsville, MN - Official Website (burnsvillemn.go

How can subsidies be optimized to align public and private incentives for EAB insecticide treatment?

Model of optimal subsidies for EAB insecticide treatment

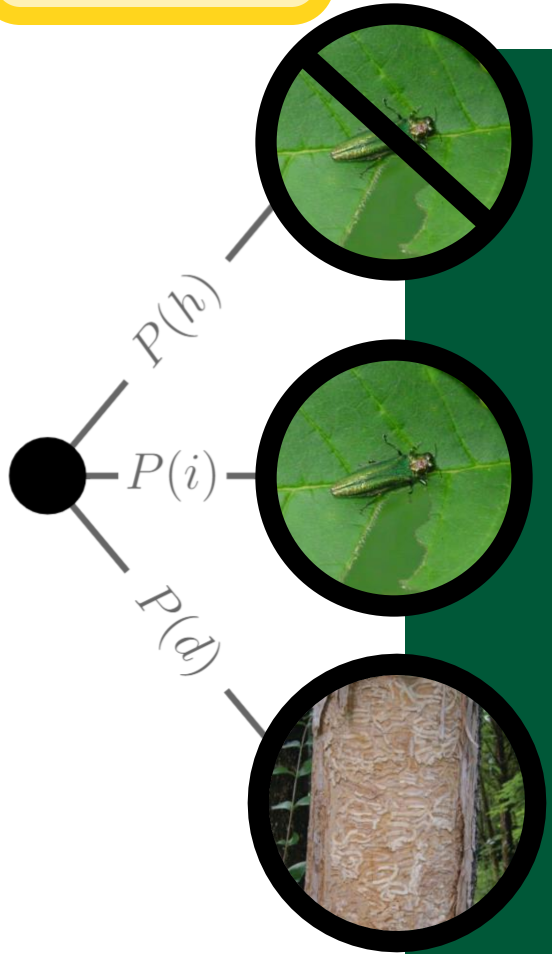
- Optimal subsidy policies for privately owned trees change as EAB spreads
  - Tree health
  - Current community state of infestation
  - Uncertainty about tree owner values

- Targeted toward privately owned trees that are unlikely to be treated

- Result in unified management across public and private land

Underlying tree states → Tree Assessment → Municipal subsidies → Simultaneous firm bids → Tree owner choices

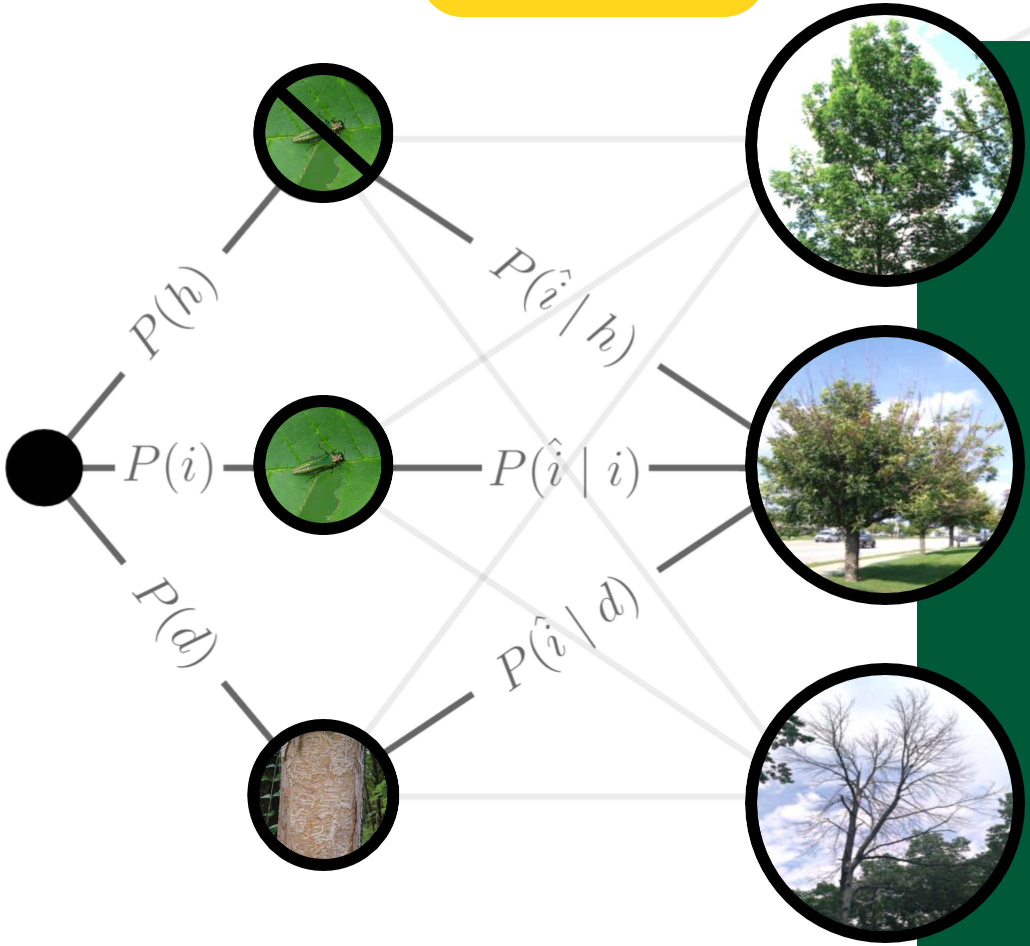
Underlying tree states → Tree Assessment → Municipal subsidies → Simultaneous firm bids → Tree owner choices



- EAB free
- Treatable EAB infestation
- Advanced EAB infestation

Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014

Underlying tree states → **Tree Assessment** → Municipal subsidies → Simultaneous firm bids → Tree owner choices



- Assessed healthy
- Assessed infested (treatable)
- Assessed dying / dead (untreatable)

Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014

Underlying tree states → **Tree Assessment** → Municipal subsidies → Simultaneous firm bids → Tree owner choices

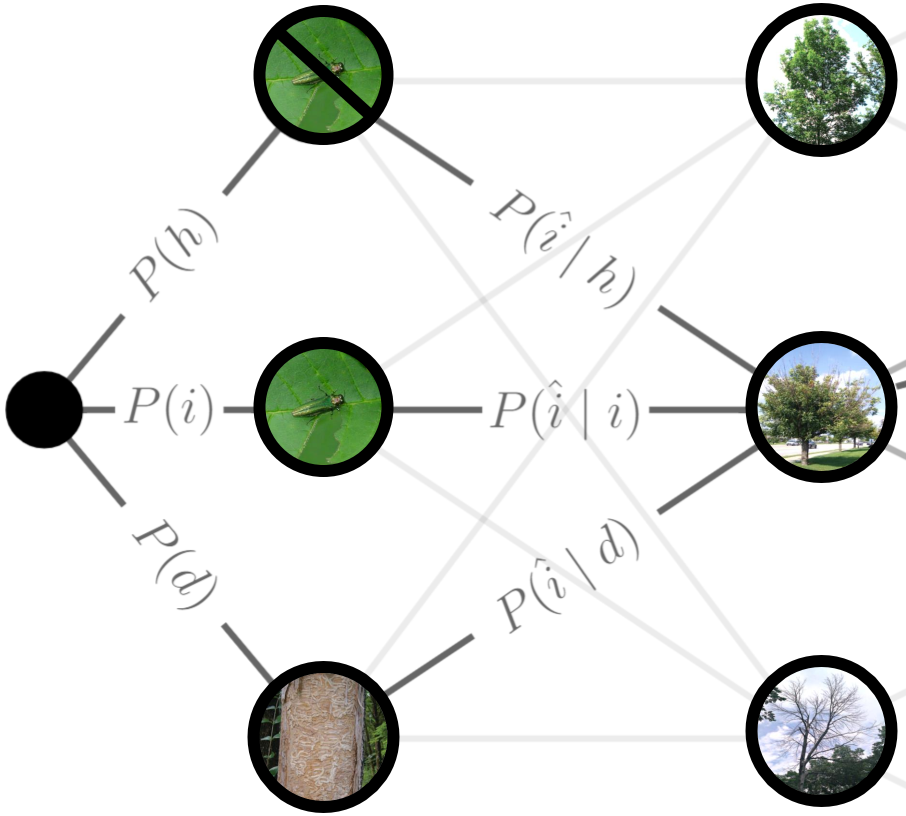
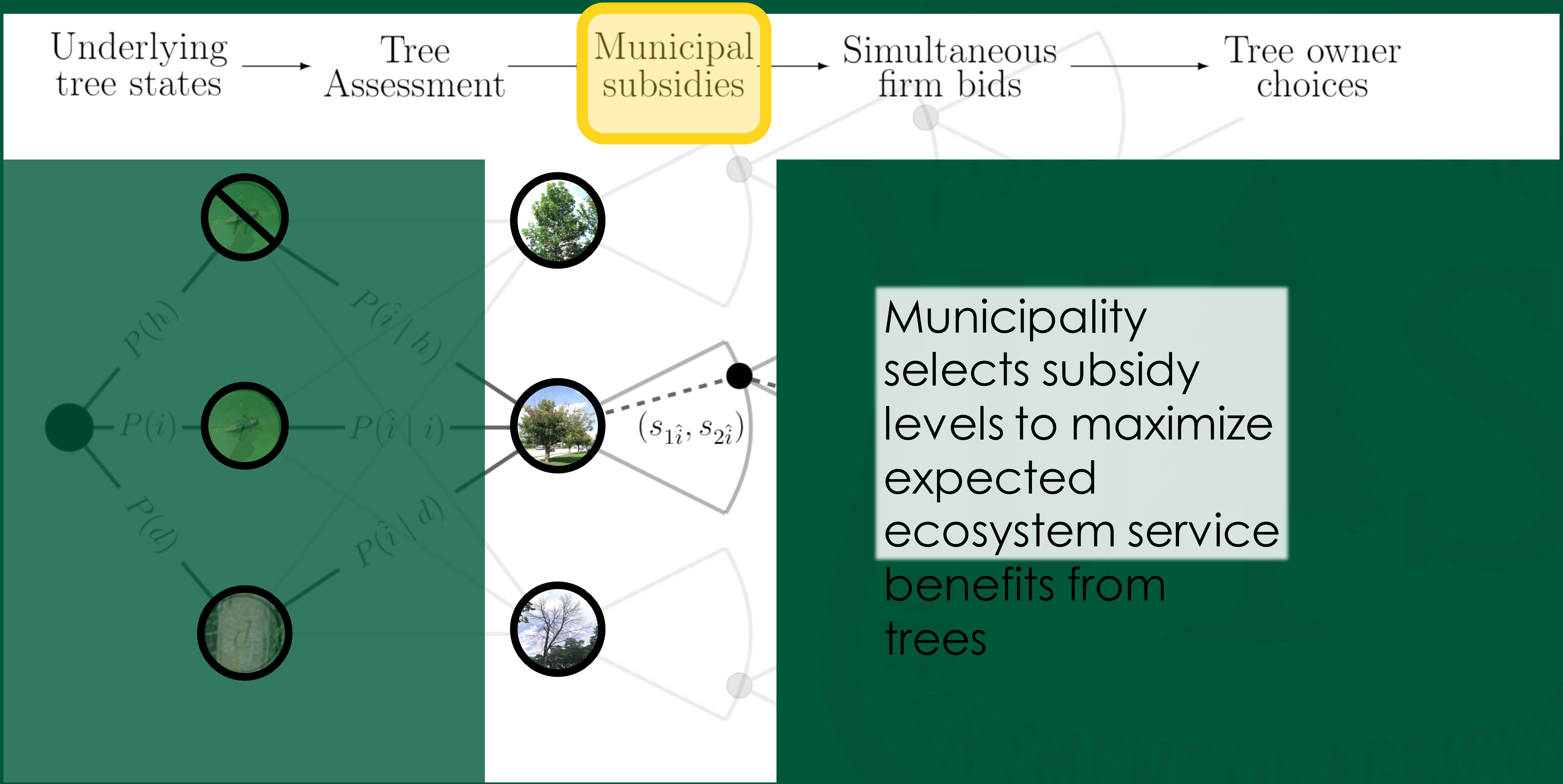


Table 1.—Ash canopy condition rating scale used to quantify degree of decline and dieback of ash trees (*Fraxinus* spp.)

Rating	Description
1	Canopy is full and healthy
2	Canopy has started to lose leaves (thinning), but no dieback (dead top canopy twigs without leaves) is present
3	Canopy has less than 50% dieback
4	Canopy has more than 50% dieback
5	Canopy has no leaves, epicormic sprouts may be present on the trunk

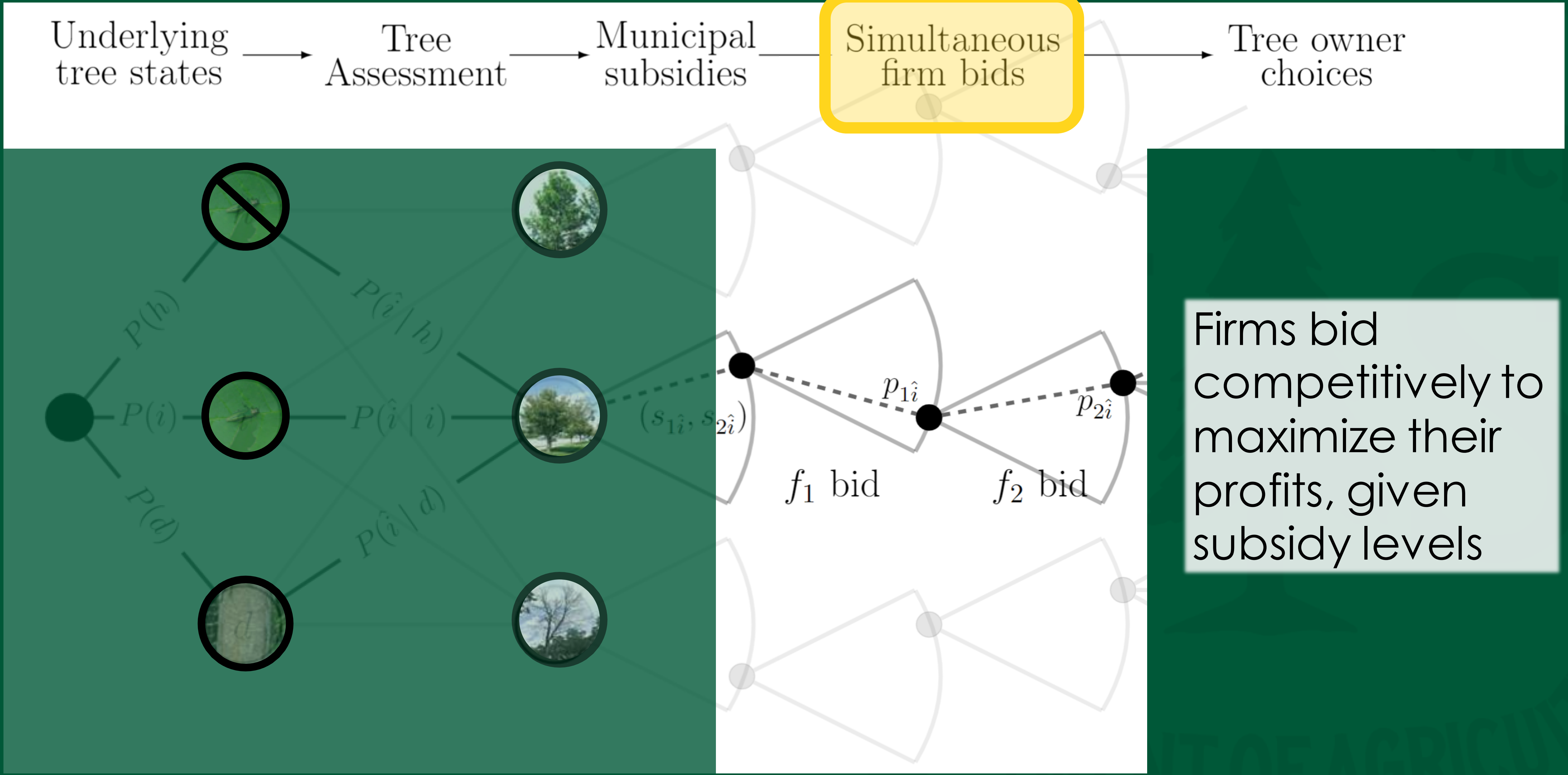
Table from: Knight, Flash, Kappler, Throckmorton, Grafton, and Flower; 2014; FS General Technical Report

Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014



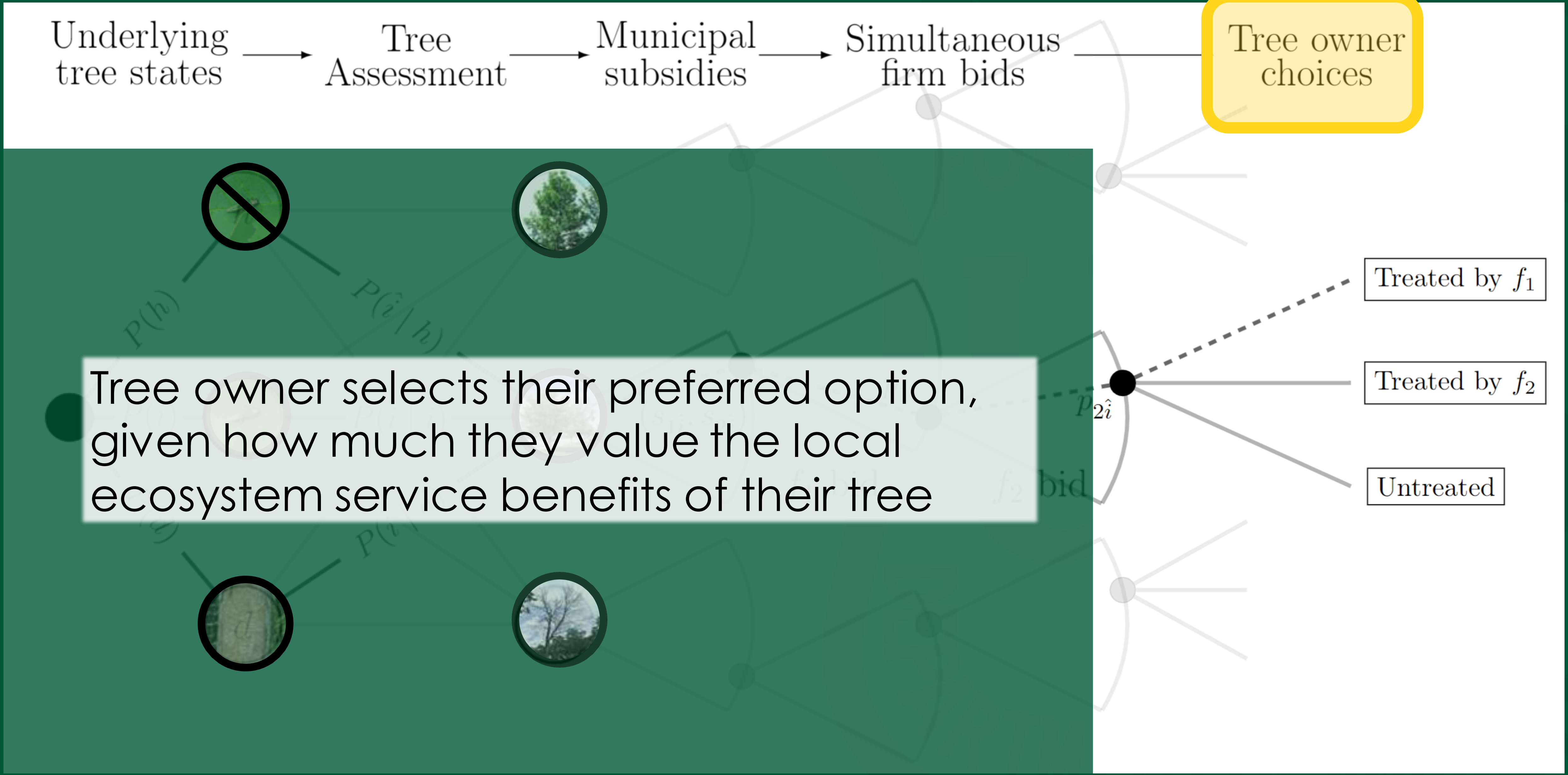
Municipality selects subsidy levels to maximize expected ecosystem service benefits from trees

Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014



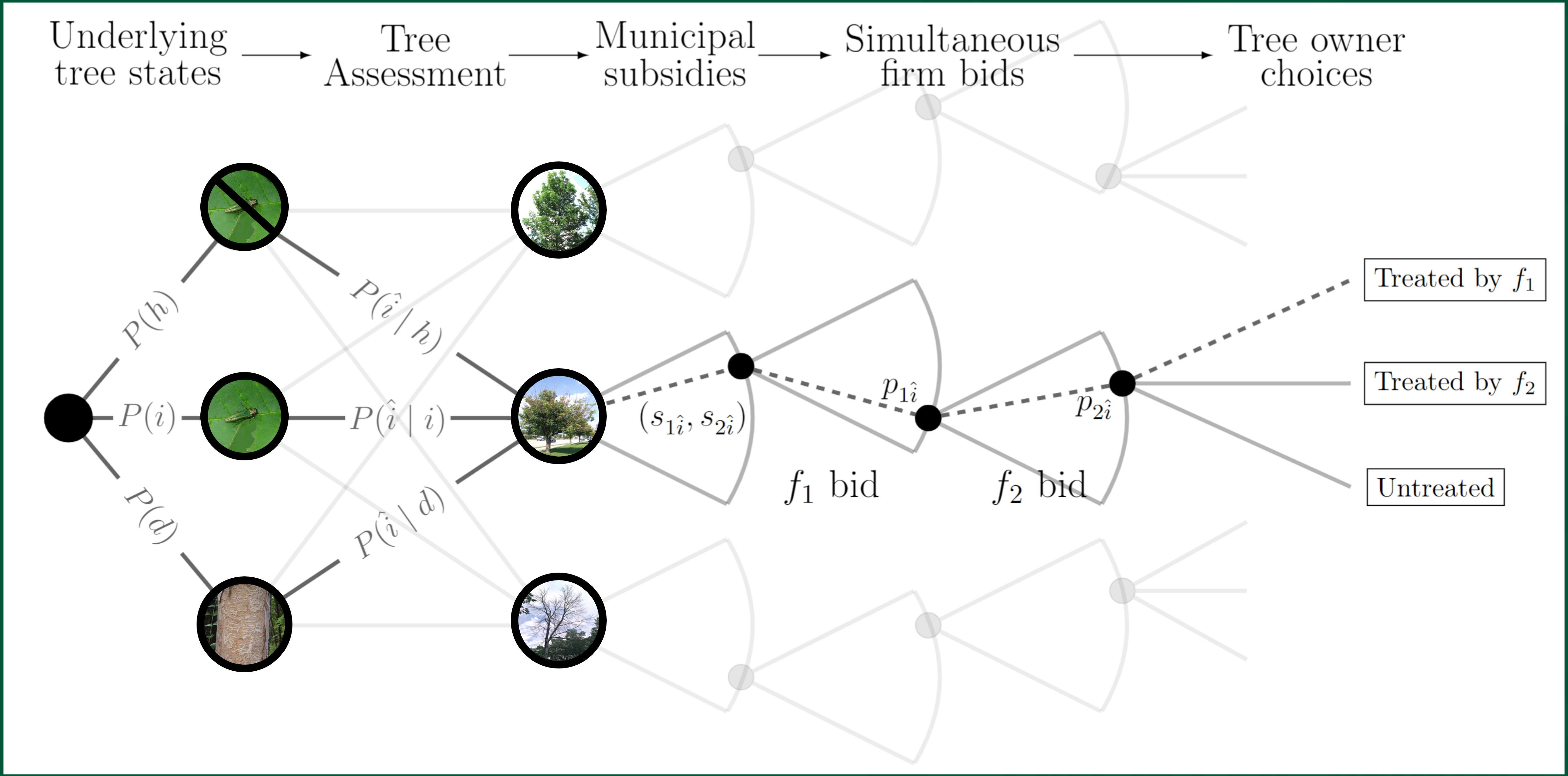
Firms bid competitively to maximize their profits, given subsidy levels

Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014

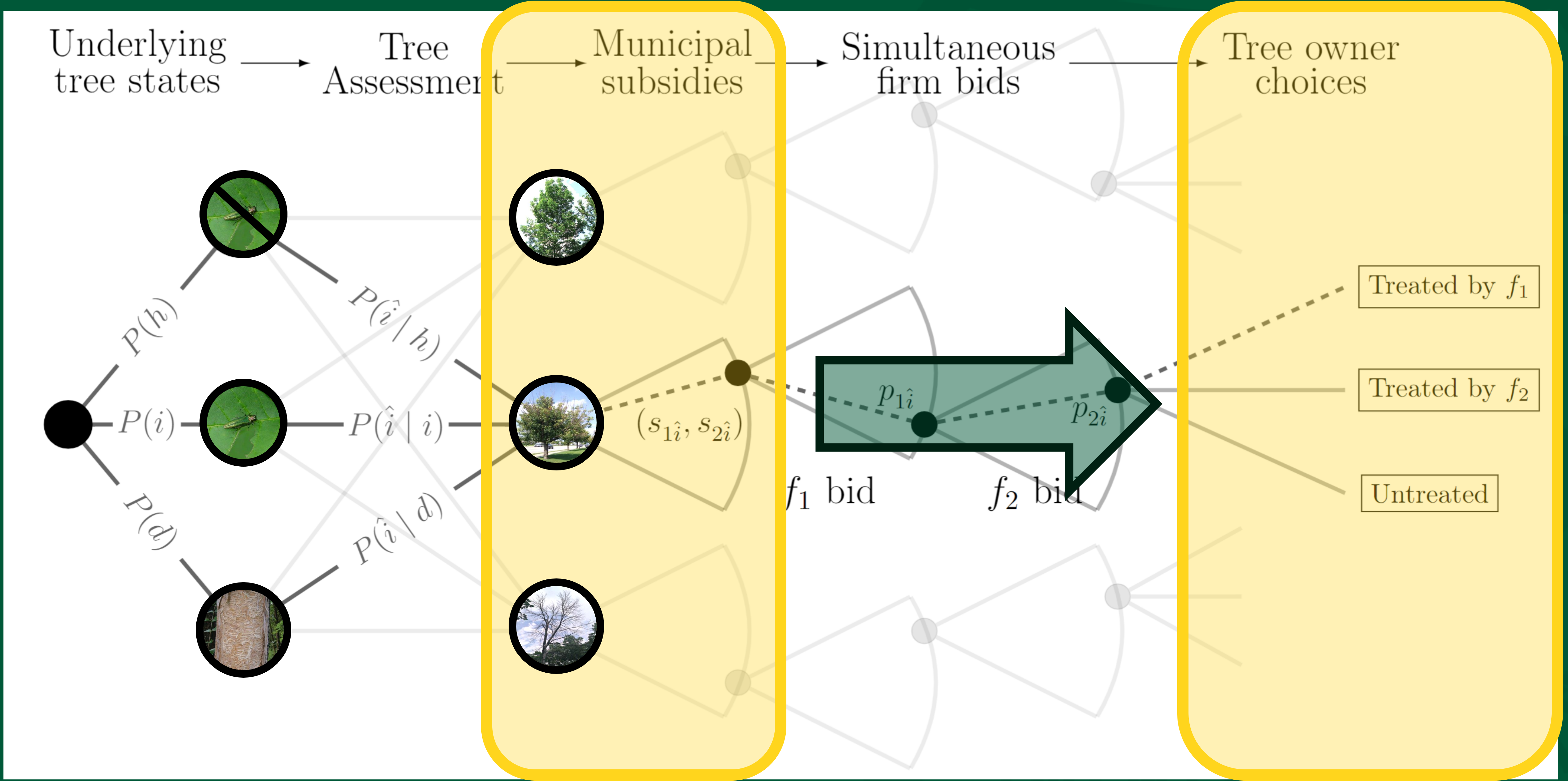


Tree owner selects their preferred option, given how much they value the local ecosystem service benefits of their tree

Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014



Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014



Pictures from: Region 9 - Emerald Ash Borer Threat Webinar Series and Knight et. al., 2014

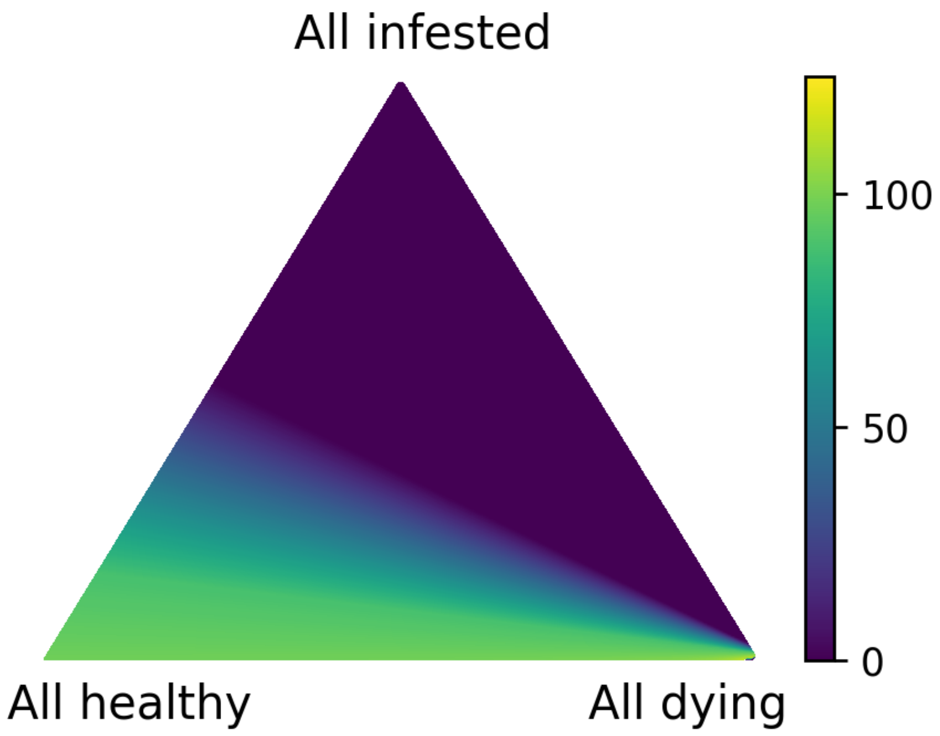
Key parameters

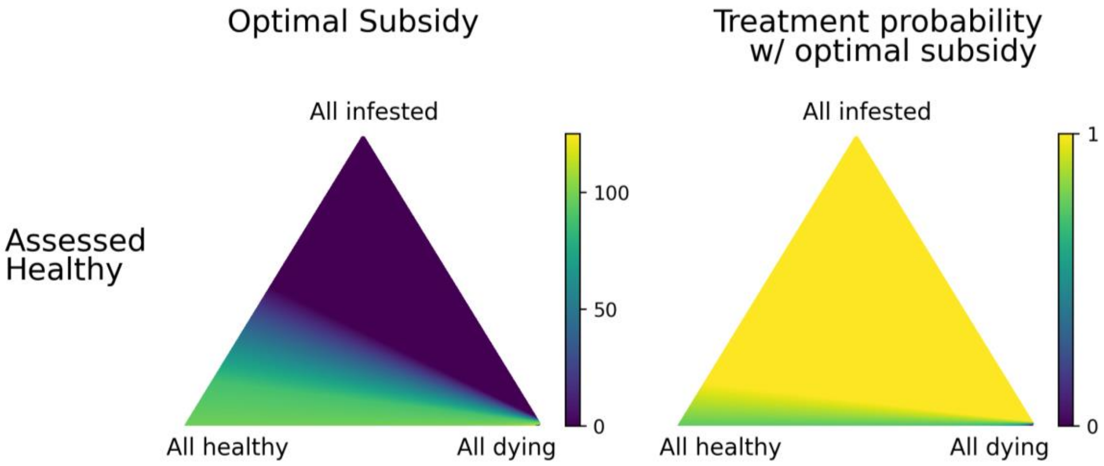
- Cost of administering treatment
- Community prevalence of EAB infestation
  - Surveillance data
- Accuracy of assessment
  - False positives / false negatives
- Effectiveness of insecticide treatment
  - A function of tree health
- Social and private value of saving an ash tree
  - Divergence in values expected due to cross-boundary ber

Parameter
c
$P(h)$
$P(i)$
$P(d)$
$P(\hat{h} \mid h)$
$P(\hat{i} \mid h)$
$P(\hat{d} \mid h)$
$P(\hat{h} \mid i)$
$P(\hat{i} \mid i)$
$P(\hat{d} \mid i)$
$P(\hat{h} \mid d)$
$P(\hat{i} \mid d)$
$P(\hat{d} \mid d)$
h_{th}
h_{uh}
h_{ti}
h_{ui}
h_{td}
h_{ud}
Δ_m
Δ'_m
Δ_o

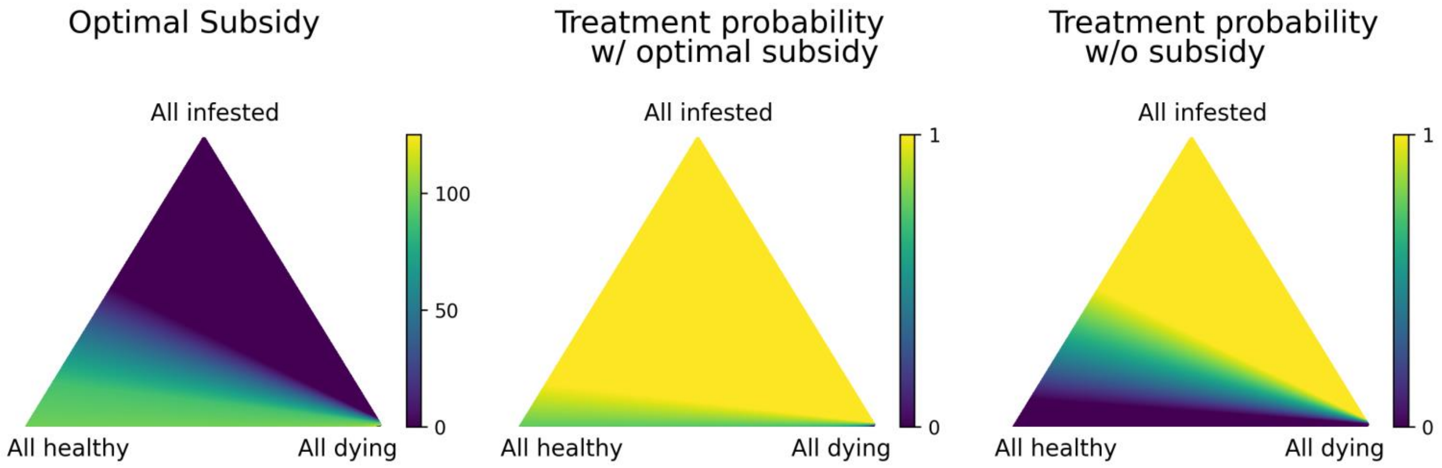
Optimal Subsidy

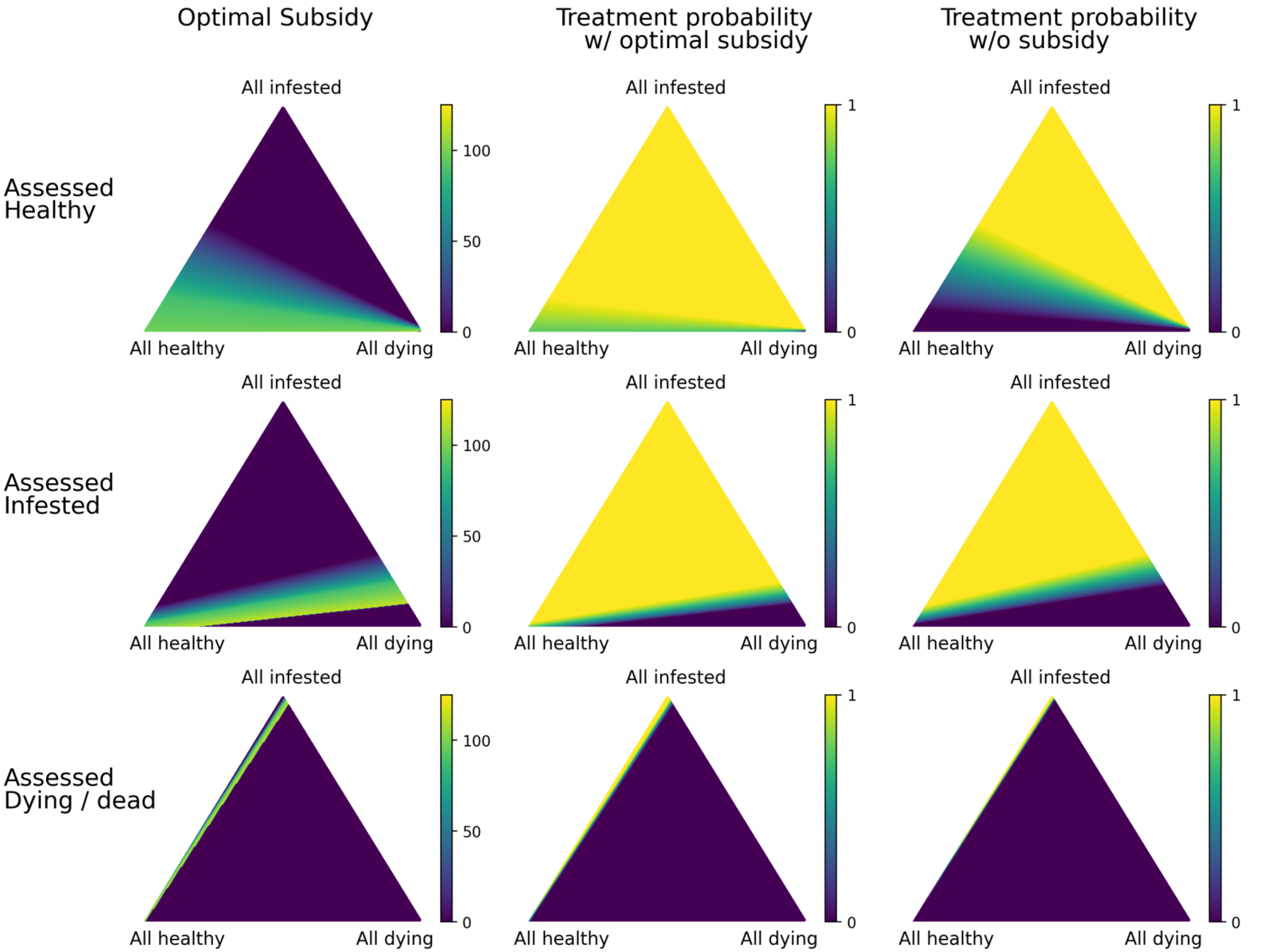
Assessed Healthy




Optimal Subsidy
Treatment probability w/ optimal subsidy
Assessed Healthy
All infested
All healthy
All dying
100
50
0
All infested
All healthy
All dying
1
0

Assessed Healthy




Optimal Subsidy
Treatment probability w/ optimal subsidy
Treatment probability w/o subsidy
Assessed Healthy
Assessed Infested
Assessed Dying / dead
All infested
All healthy
All dying
0
50
100
1

Take-home messages

- Subsidies can help private landowners sustain the community benefits of urban forests

- Optimal subsidy policies are dynamic:
  - –Tree health state
  - –Current community state of infestation
  - –Uncertainty about tree owner values

- Maximum treatment benefit ≠ maximum subsidy
  - –Subsidy targeted to increase treatment uptake

Thank you

Andrew R. Tilman | USDA Forest Service

andrew.tilman@usda.gov

USDA

Forest Service
U.S. DEPARTMENT OF AGRICULTURE

2nd World Forum on Urban Forests

2023

World Forum on Urban Forests

2nd World Forum on Urban Forests

Washington DC, 2023

URBAN TREE GUARD

Safeguarding European urban forests and trees through improved biosecurity

UB3GUARD

Presented by

Dr Dinka Matošević

Croatian Forest Research Institute

Croatia

cost

EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

UrbanTreeGuard

BACKGROUND

- ❖Urban trees are increasingly threatened by alien pests (insects and pathogens) that are introduced via trade and transports.
- ❖In a new environment, these pests may become invasive, causing devastating environmental and economic losses, and threatening also unique cultural values, such as those linked to veteran trees.
- ❖Invasive alien species are a major threat to nature, nature's contributions to people, and good quality of life (IPBES 2023)
- ❖The current biosecurity system fails to capture alien pests that often also benefit from the altered climate.
- ❖COST Action "UrbanTreeGuard" (CA20132) brings together a pan-European and international network of scientists and stakeholders to meet this challenge.

UrbanTreeGuard

MOTIVATION

- 70% of the EU population (about 335 Million people) in cities, towns and suburban areas
- Trees provide multiple essential ecosystem services for people
- Urban forests and trees mitigate harmful influence of climate change
- *The threat*: entry points for pest and pathogens

UrbanTreeGuard
GOALS

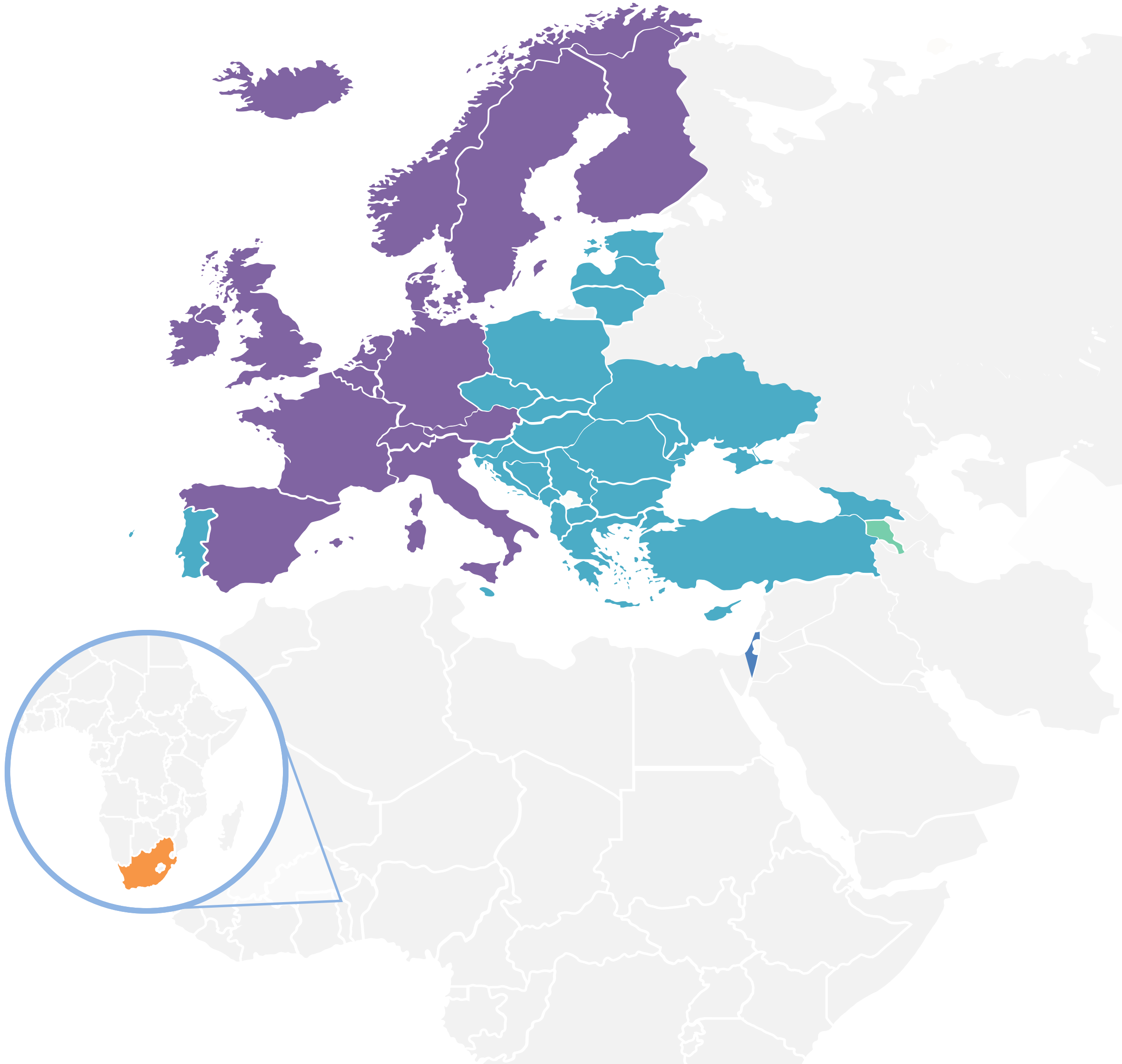
UrbanTreeGuard network aims to:

- ❖**Collect, share and harmonize** scientific and **stakeholder knowledge**.
- ❖**Accelerate development of innovative technological tools and solutions for biosecurity purposes.**
- ❖**Inform policy and support implementation of the EU plant health regime** while providing science-based recommendations for decision makers, especially at operational levels.
- ❖Foster an **inclusive and open research environment**, with explicit support to young professionals.
- ❖**Increase European competitiveness** in the field of biosecurity, **improving also the quality of everyday life** for people, especially urban dwellers, in Europe and beyond.
- ❖start: 2021-end: 2025 (4 years)

URBAN TREE GUARD Membership

41 Members

- Albania
- Armenia
- Austria
- Belgium
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Georgia
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- The Republic of Moldova
- Montenegro
- The Netherlands
- The Republic of North Macedonia
- Norway
- Poland
- Portugal
- Romania
- Serbia
- Slovakia
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- Ukraine
- United Kingdom



Working Groups (WGs)

WG 1 - Identification

Finding the relevant stakeholder groups and understanding their needs.

WG 2 - Innovation

Mapping and recommending available tools and measures for urban tree biosecurity.

WG 3 - Integration

Informing policy, identifying obstacles and suggesting measures for policy implementation.

WG 4 - Information

Transparent and rapid communication and dissemination activities and knowledge exchange.

Urban trees from a biosecurity perspective

- ❖Urban trees: first location of introductions of invasive forest pests

- ❖WG1: Identification of stakeholder needs for urban tree biosecurity
  - What trees are planted in European cities?
  - Are urban tree species selected with a focus on biotic damages/potential invasive forest pests?

Biol Invasions (2017) 19:3515–3526
DOI 10.1007/s10530-017-1595-x
CrossMark
URBAN INVASIONS

Urban trees: bridge-heads for forest pest invasions and sentinels for early detection

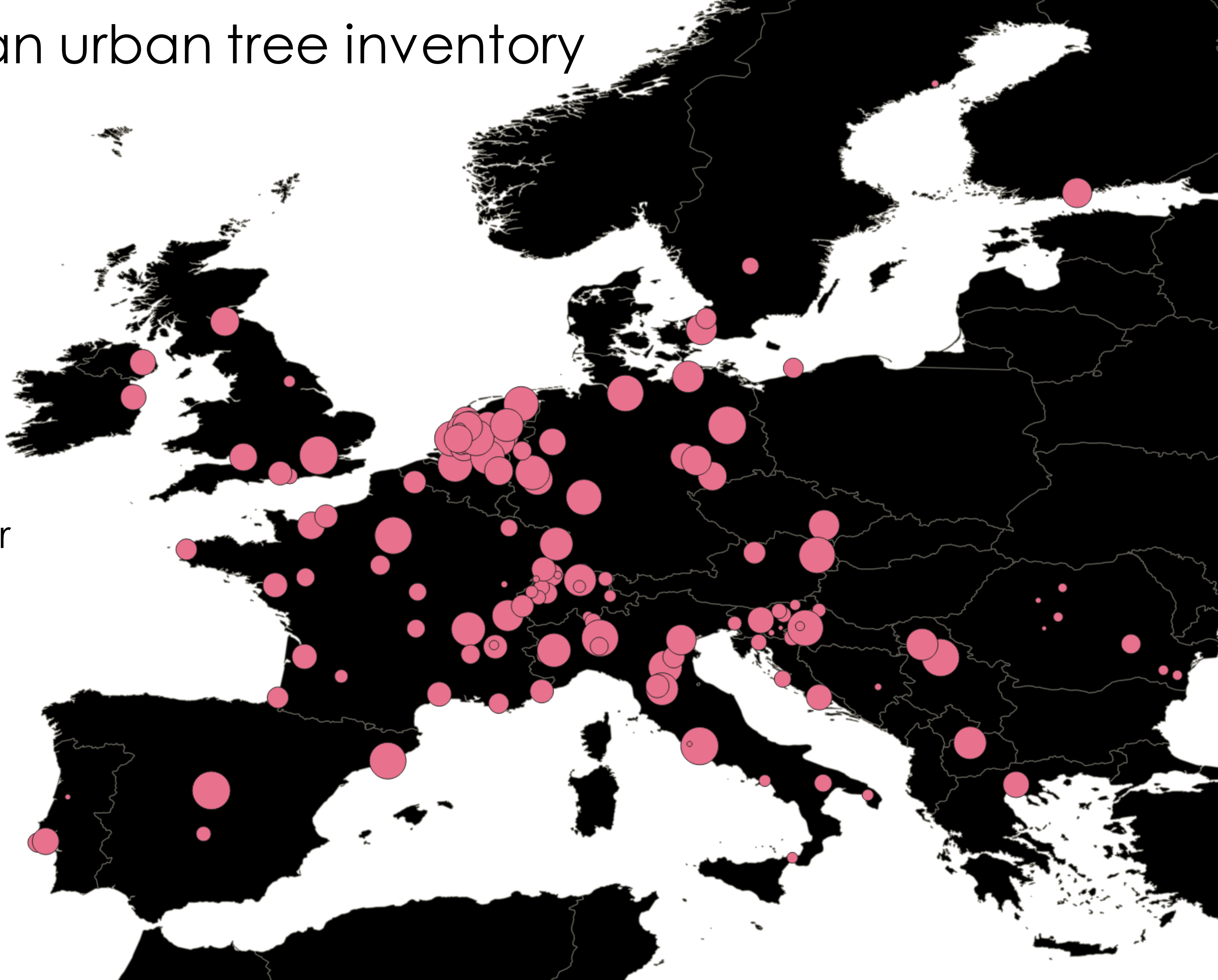
Trudy Paap · Treena I. Burgess · Michael J. Wingfield

Urban trees facilitate the establishment of non-native forest insects

Manuela Branco[1], Pedro Nunes[1], Alain Roques[2], Maria Rosário Fernandes[1], Christophe Orazio[3], Hervé Jactel[4]

European urban tree inventory

- 28 countries
- >170 inventories
- ~200 - >700,000 trees per inventory
- ~8,9 mio trees in total
- >2,700 species



Most common trees-percentage of all trees by number





Species	Percent
Acer platanoides	4.9
Quercus robur	4.8
Fraxinus excelsior	4.2
Platanus x hispanica	3.7
Tilia cordata	3.5
Acer pseudoplatanus	3.4
Aesculus hippocastanum	2.7
Tilia xeuropaea	2.6
Carpinus betulus	2.5
Celtis australis	2.4





Most common trees-presence in inventories





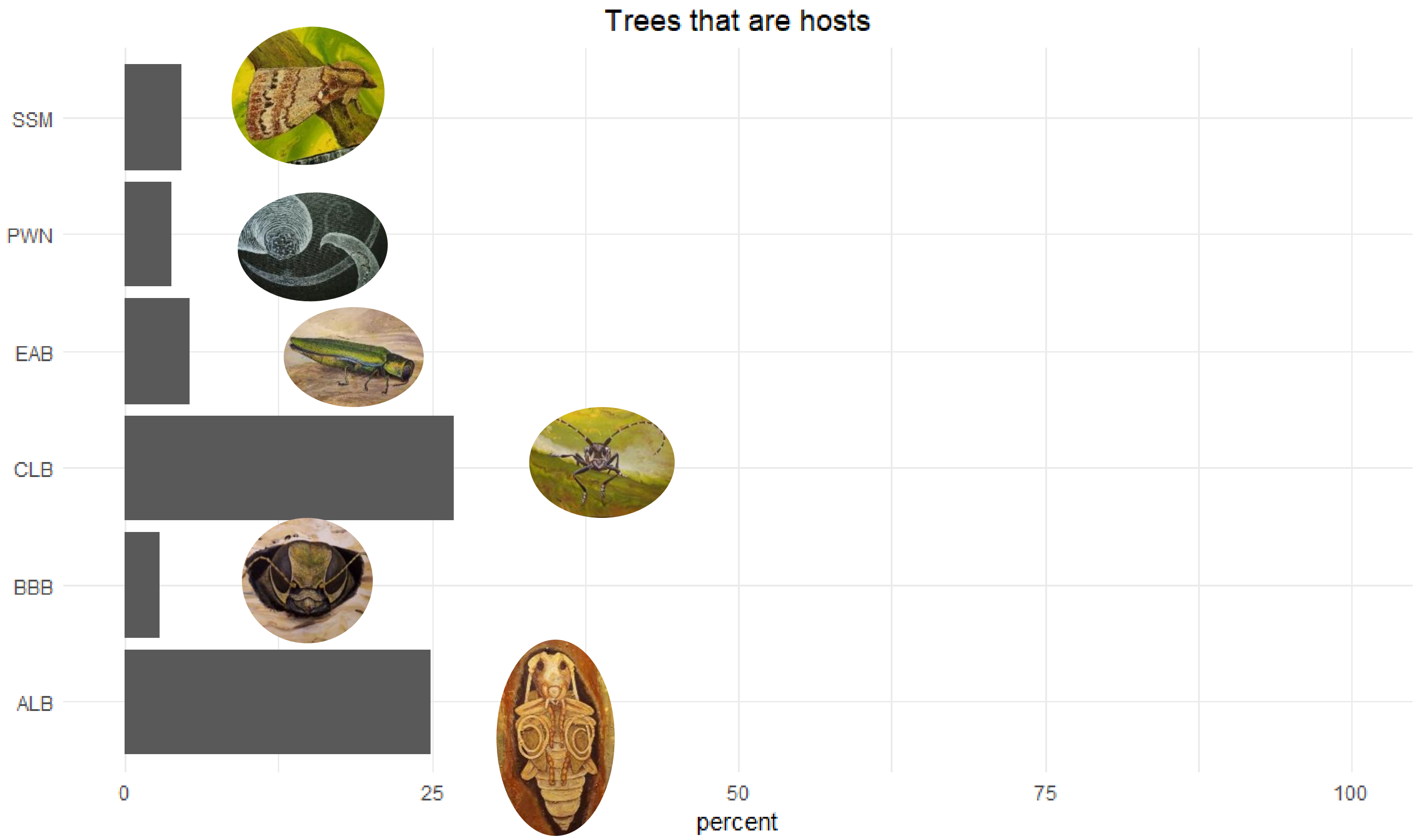
Species	Percent
Tilia cordata	91.6
Acer platanoides	89.6
Aesculus hippocastanum	89.6
Robinia pseudoacacia	89.6
Acer pseudoplatanus	88.3
Carpinus betulus	87.0
Juglans regia	86.4
Liriodendron tulipifera	86.4
Quercus robur	86.4
Acer negundo	85.7





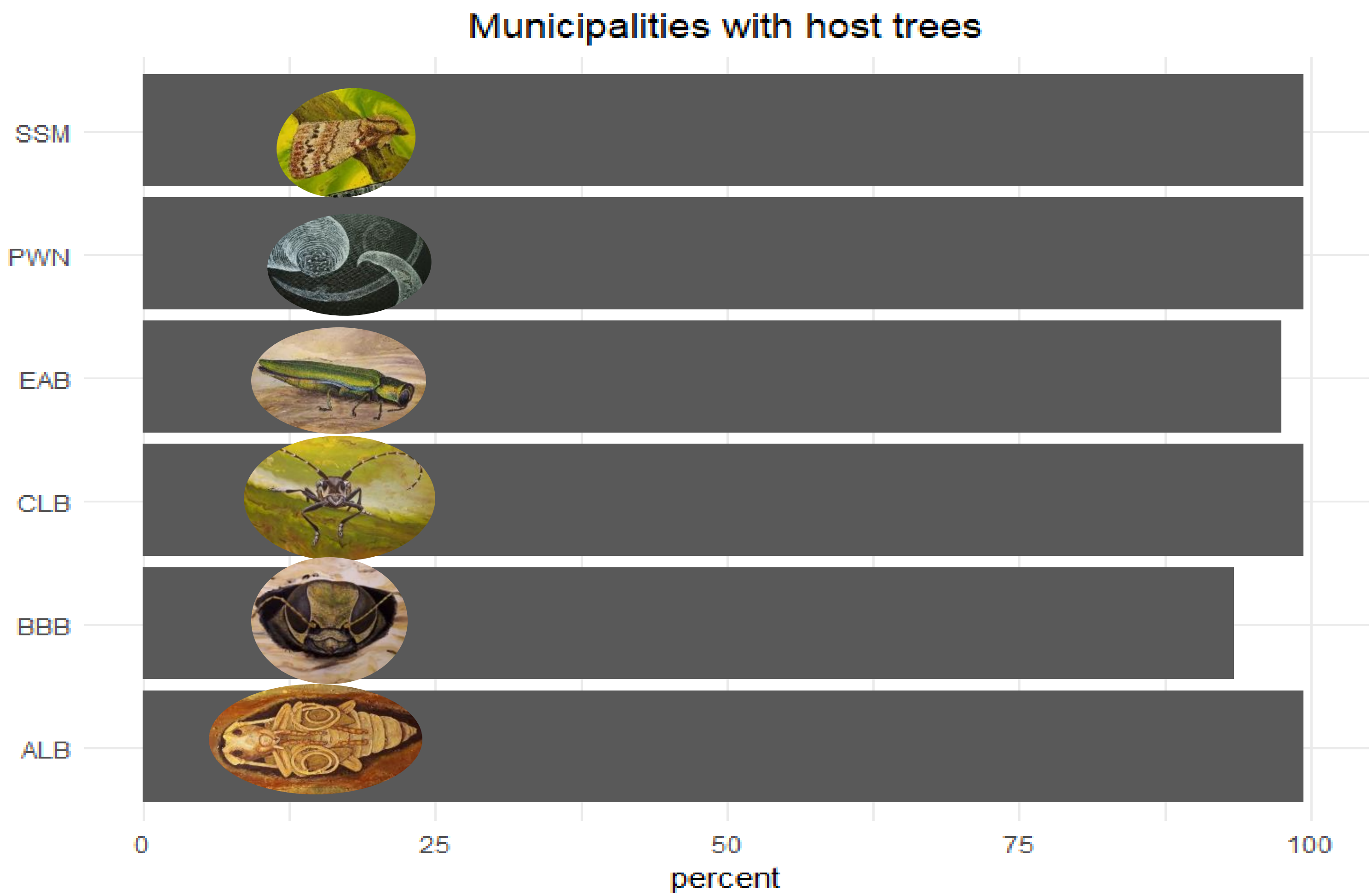
Susceptibility of urban trees to invasive forest pests
EFSA priority quarantine pests

Species
Siberian silk moth *Dendrolimus sibiricus*
Pinewood nematode *Bursaphelenchus xylophilus*
Emerald ash borer *Agrilus planipennis*
Chinese longhorn beetle *Anoplophora chinensis*
Bronze birch borer *Agrilus anxius*
Asian longhorn beetle *Anoplophora glabripennis*



Urban trees as stepping stones for invasive forest pests

Species
Siberian silk moth *Dendrolimus sibiricus*
Pinewood nematode *Bursaphelenchus xylophilus*
Emerald ash borer *Agrilus planipennis*
Chinese longhorn beetle *Anoplophora chinensis*
Bronze birch borer *Agrilus anxius*
Asian longhorn beetle *Anoplophora glabripennis*

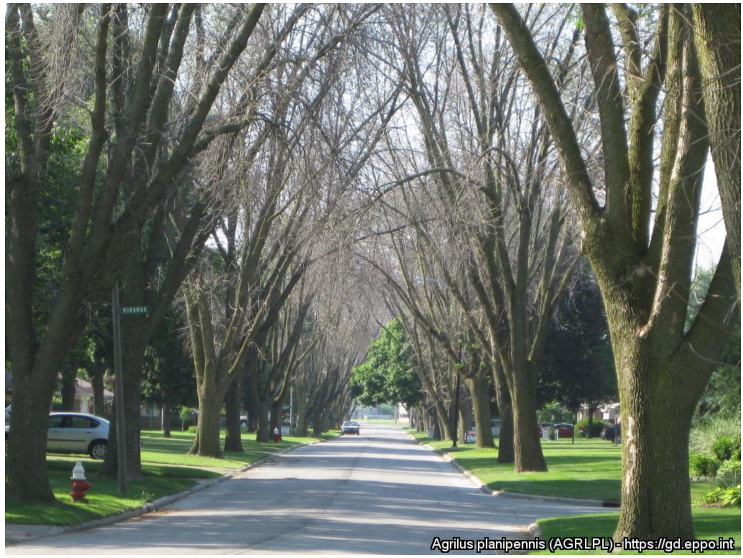


Approaching invasive forest pests in Europe
Emerald Ash Borer

- Emerald Ash Borer in Europe
  - First detected in 2003 near Moscow
  - Spreading
- Concerning, because 5.3% of trees in the EU are *Fraxinus* sp.(ash)
- 97% of urban tree inventories contain *Fraxinus* sp
- In USA: >90% ash tree mortality due to emerald ash borer predicted*
- *Fraxinus excelsior* less susceptible than American Ash species**
- But : stressed trees in urban environments
- *Fraxinus* spp. in Europe are already suffering from Ash dieback
- Reason for concern

Future of Ash in European cities

- For 52 inventories: data on plant year
- ~160000 trees planted from 2018-2023
- From which 4.7% *Fraxinus* sp.
- ~7638 trees
- recommendation to plant Ash trees



*Hudgins et al., 2022, J. of Applied Ecology
**Showalter et al., 2019, Plants People Planet

Conclusions

❖EU priority quarantine pests and pathogens:
most will find abundant host trees in European cities.

❖Specific situation EAB:
Advise against planting more Ash trees in European cities

❖Urban trees: stepping stones for invasive forest pests
Monitoring opportunities

❖Generally:
Planning urban tree species: do we consider potential invasive species enough?

❖Astonishingly high species richness: *common garden experiment*

Thank you

Dinka Matošević | Croatian Forest Research Institute
Johanna Witzell, Linnaeus University, Sweden
Benno Andreas Augustinus, WSL, Switzerland
Mariella Marzano, Forest Research, UK
Martina Kičić, Croatian Forest Research institute

dinkamatosevic@gmail.com

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the European Union

Food and Agriculture Organization of the United Nations
Arbor Day Foundation
POLITECNICO MILANO 1863
SISEF
ISA
Smithsonian

2nd World Forum on Urban Forests

2023

World Forum on Urban Forests

2nd World Forum on Urban Forests
Washington DC, 2023

Montgomery Parks' Innovative Urban Forest Risk Management Program

Presented by
Colter Burkes
Senior Urban Forester
Montgomery Parks, M-NCPPC

About Montgomery Parks

Maryland-National Capitol Park and Planning Commission

- Land Ownership 11.4%
- 37,072 acres
- 8,000 Actively Maintained Acres
- 421 Parks
- >1M People

Parks’ Arboriculture

Sugarloaf Mountain Park
Tuscarora
MARYLAND
VIRGINIA
Glenelg
Dayton
Hobbit's Glen Golf Club
Natural Resource Man Area
Temple Hall Farm Regional Park
Belmont Country Club
Sterling
LOUDOUN
1757 Golf Club
Great Falls
Beltsville
Adelphi
Indian Creek

SNOWDEN FARM PKWY
FOREMAN BLVD
GRAND ELM ST
BOULDER HEIGHTS TER
FLINT TAVERN TER
TULIP TREE TER
ICY BROOK LN
ICY BROOK LN
BRASS LANTERN WAY
CRIMSON IVY LN
BLUE SKY DR
TARHEEL LN
CREEK BEND LN
TURTLE ROCK TER
JAGUAR LN
SHAWNEE LN
TIMBER CREEK LN
CLARKBROOKE DR
SNOWDEN FARM PKWY
FOREMAN BLVD
BLUE FOX TER
BASS POND TER
BASS POND LN
CARRIAGE PARK PL
TURTLE ROCK TER
SYCAMORE FARM DR
CHESTNUT GLEN RD
BASSWOOD HILL DR
BIRCH MEAD RD
SASSAFRAS WAY
WINGED ELM DR
MAGNOLIA PARK PL
BUTTERNUT GROVE DR
POND PINE DR
CYPRESS SPRING RD
SYCAMORE FARM DR
SYCAMORE FARM DR
SYCAMORE FARM DR
LITTLE SENECA PKWY

Hazard Tree Inspection

Work Prioritization

- Inspection – **30 days**

- Critical- **ASAP**
- High Risk – **30 days**
- Medium-high Risk – **90 days**
- Moderate Risk – **3-12 months**
- Low Risk – **No work required**

Hazard Tree Work

Massachusetts Self Help Rule

- You can cut branches or roots from a tree on your neighbor's property that extends into your property
- When a tree or its branches fall, it is considered an "Act of God," unless the tree was known to be dead or hazardous

Hensley v. Montgomery County (1975)

Melnick v. C.S.X Corp.(1988)

TreeKeeper

jesu

Tree Benefits

i-Tree Eco Tree Benefits

Trees Benefits

37,499
Calculated Trees

i-Tree Powered

319 Selected Sites

Total Benefits Over 20 Years

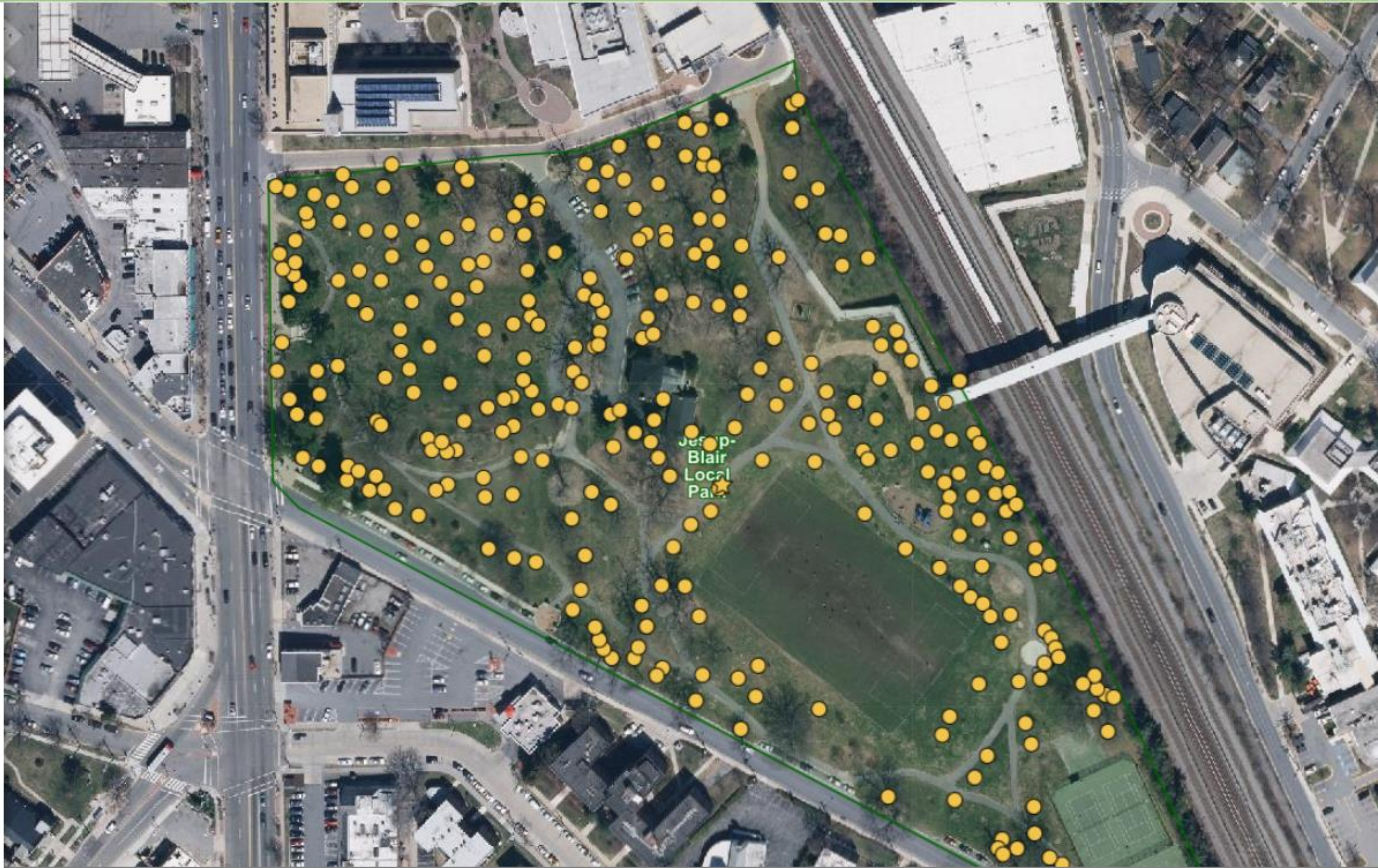
$105,573.85

Carbon Dioxide Uptake
$20,355.17
Carbon Sequestered 238,699.06 pounds
CO2 Equivalent 875,229.89 pounds

Storm Water Mitigation
$20,563.86
Runoff Avoided 2,301,235.71 gallons
Rainfall Intercepted 9,019,853.91 gallons

Air Pollution Removal
$64,654.83
Carbon Monoxide 2,270.54 ounces
Ozone 83,157.93 ounces
Nitrogen Dioxide 11,493.17 ounces
Sulfer Dioxide 3,340.19 ounces
$PM_{2.5}$ 4,538.42 ounces

Energy Benefits



Thank you

Colter Burkes
Senior Urban Forester
Montgomery Parks

Colter.Burkes@montgomeryparks.org

2nd World Forum on Urban Forests

2023

World Forum on Urban Forests

2nd World Forum on Urban Forests

Washington DC, 2023

Urban Forests and related pollen allergy: from the Phanton Menace to the New Hope

Presented by

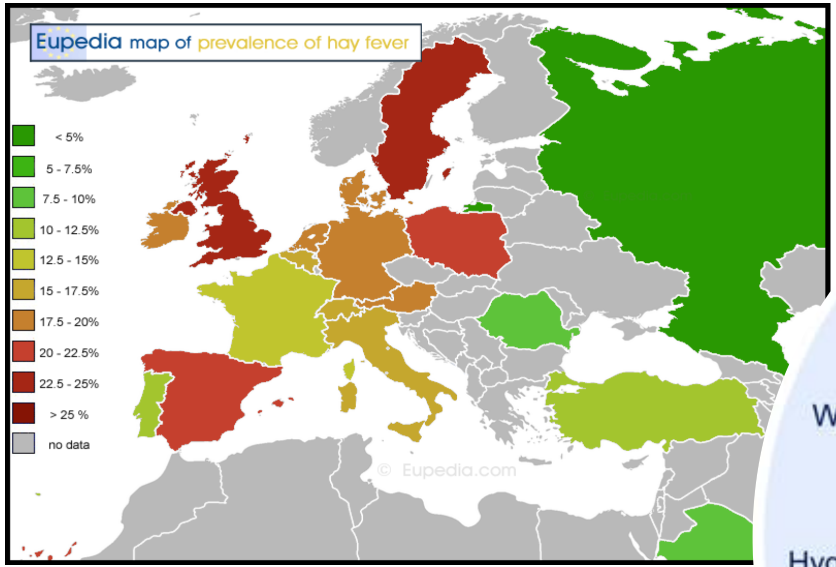
Paloma Cariñanos

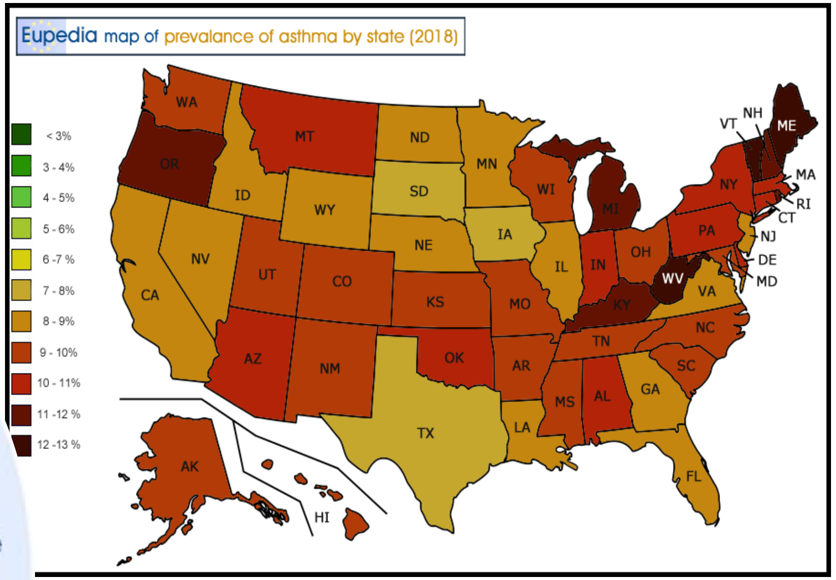
Dept. Botany. Andalusian Institute for Earth System Research (IISTA-CEAMA)

University of Granada, Spain

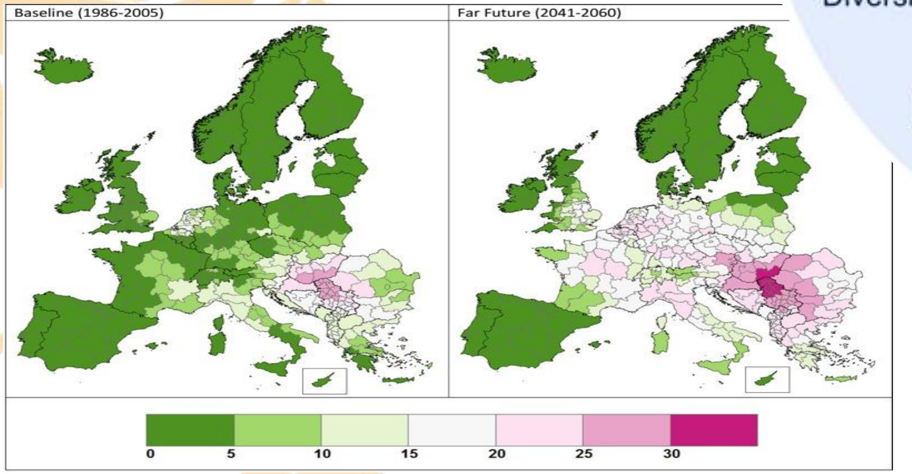
2nd World Forum on Urban Forests
Washington DC, 2023

ONE-HEALTH CONCEPT AND THE BURDEN OF ALLERGIC DISEASES

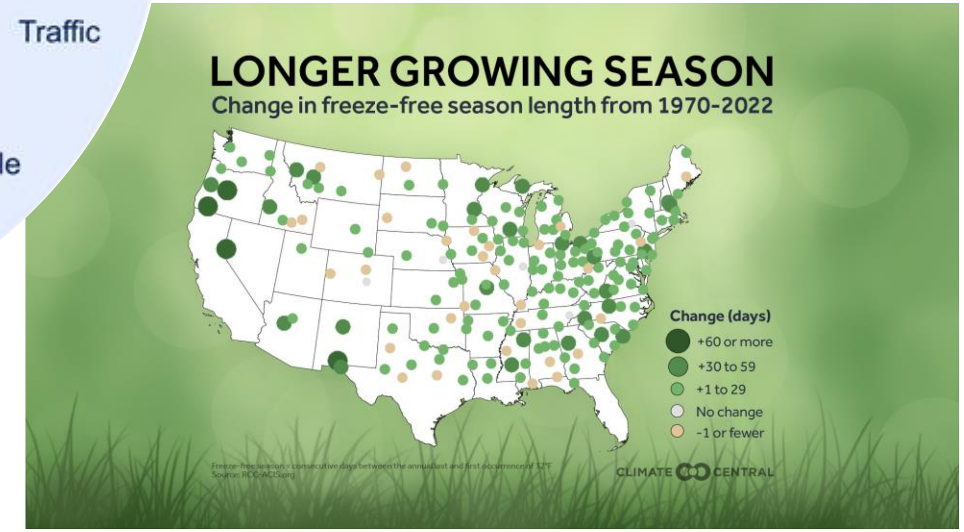




Global Wex Index 2020

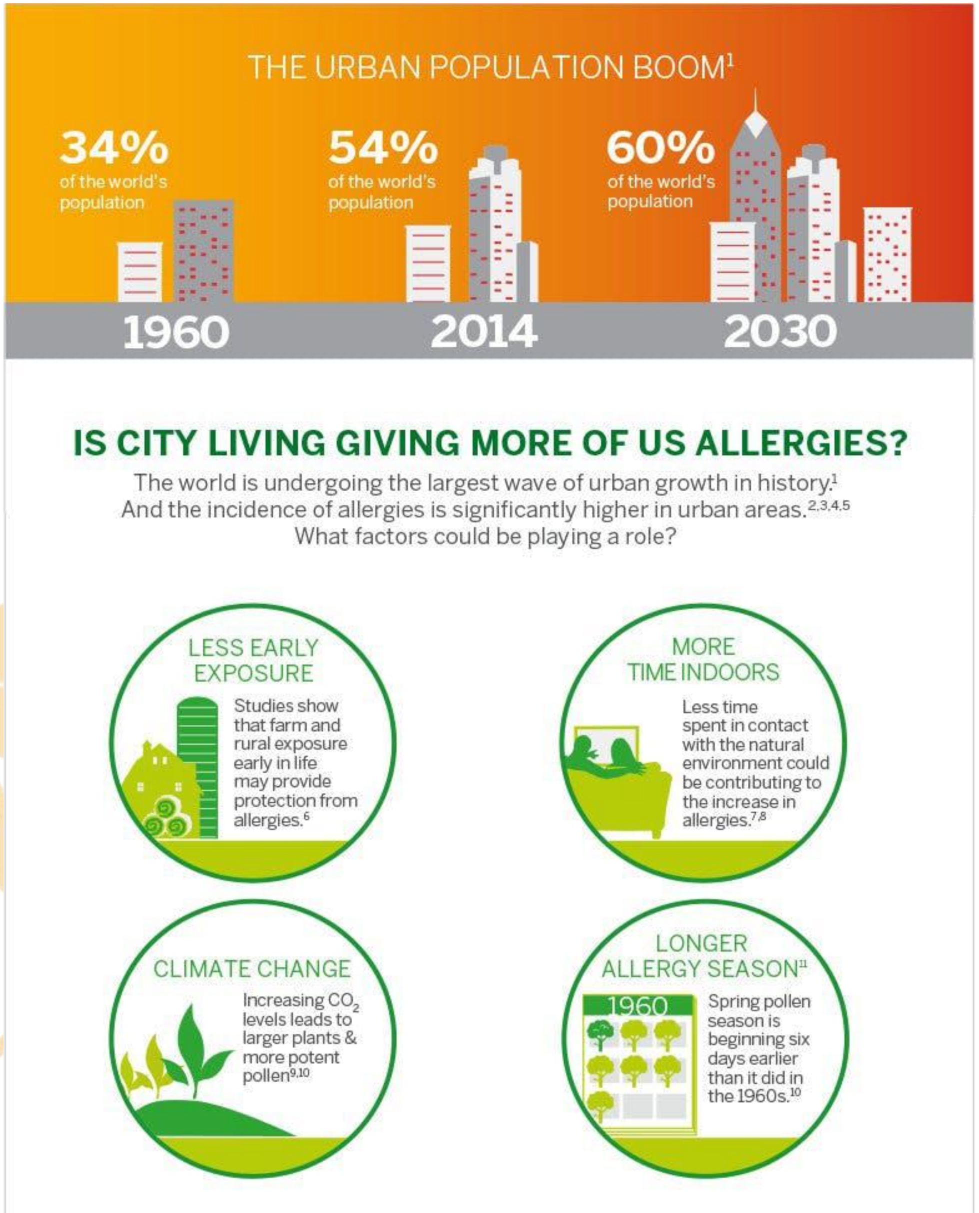


Shift in geographical distribution of

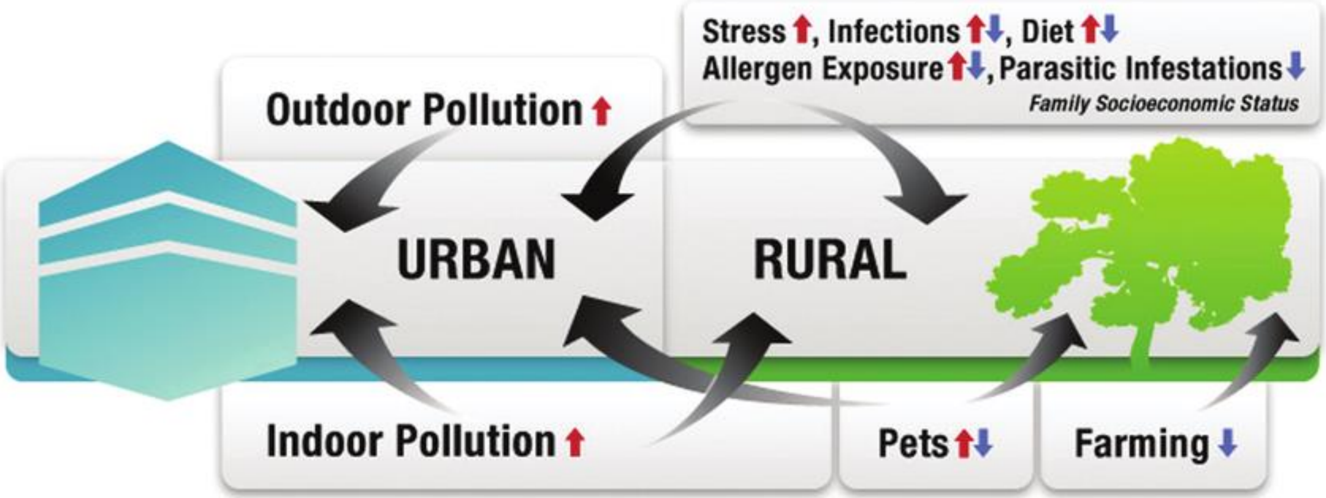


Longer growing season

ONE-HEALTH CONCEPT AND THE BURDEN OF ALLERGIC DISEASES



- MAJOR RATE OF POLLEN ALLERGY IN URBAN THAN IN RURAL AREAS
- POLLEN FROM TREES WITH HIGH FREQUENCY IN URBAN FORESTS ARE INCREASING THEIR ANNUAL POLLEN INTEGRAL (APIn)
- THE INTERACTIONS WITH AIR POLLUTANTS MAY HAVE AN AGGRAVATE EFFECT ON THE SYMPTOMATIC RESPONSE OF ALLERGICS

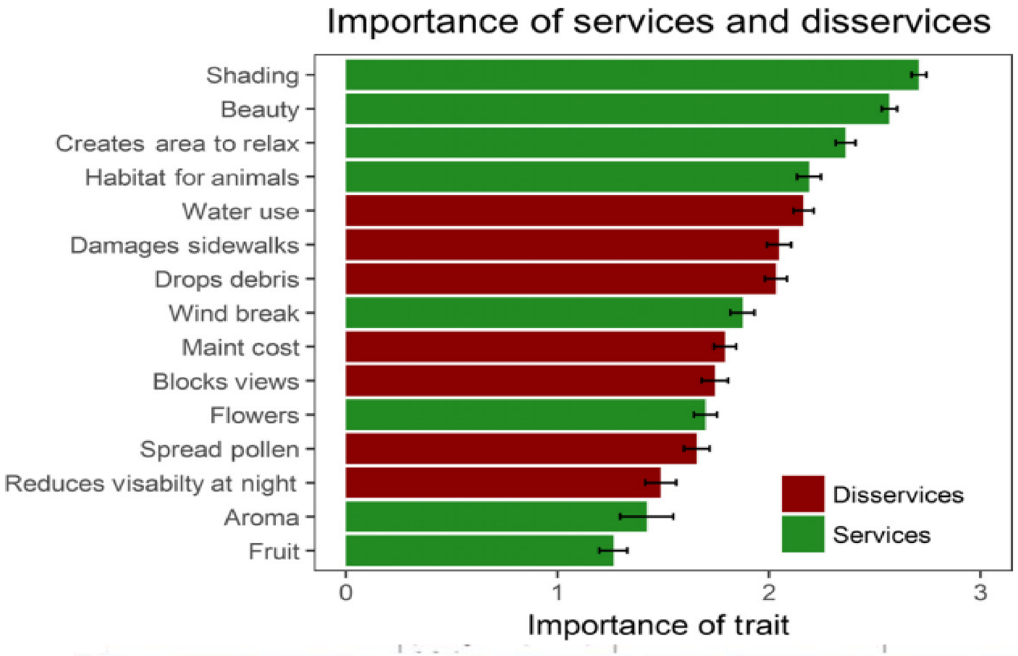


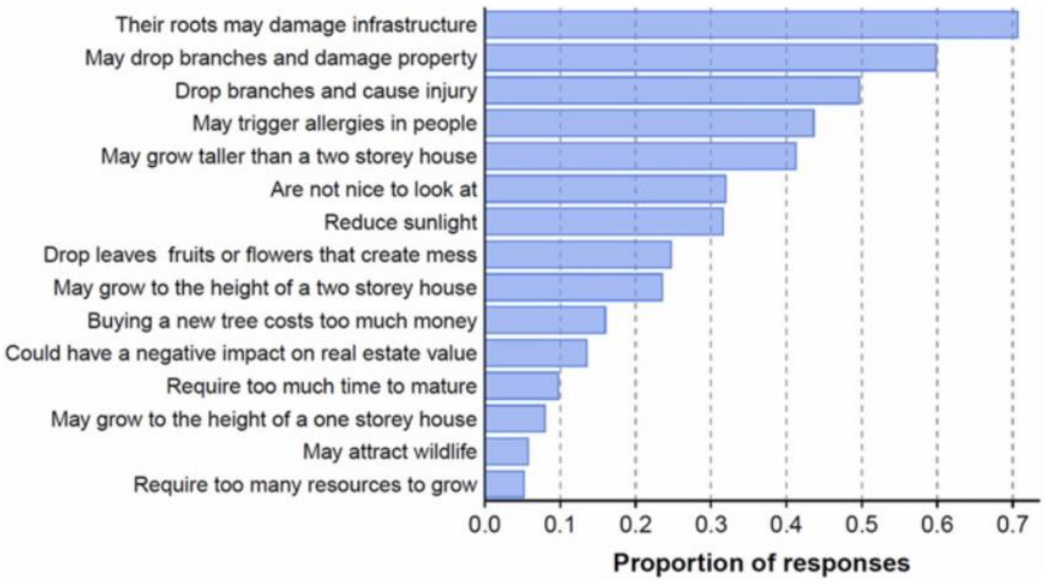
Conceptual model showing the effect of various environmental factors on asthma and allergies in children residing in urban versus rural areas (Prifitis et al., 2009)

POLLEN EMISSIONS AS ECOSYSTEM DISSERVICE

Table 9.1 Environmental, ecological, economic, health and social costs related to urban trees (ecosystem disservices)

Environmental/ecological	Health hazards	Economic costs	Social hazards
Pollutant emissions (pollen, BVOCs)	Pollen-related allergies	Maintenance costs*	Fear of crime
Water consumption	Insect bites	Costs to repair damage to infrastructure (pavements, side-walks, sanitary pipes, telecommunications)	Fear of animals (insects, rodents, snakes, bats)
Introduction of non-native /invasive species	Toxic/poisonous substances (mushrooms, berries)	Costs of treatment of pests and diseases	Psychological impact caused by trees (sound, smell, behavior)
Displacement of native species	Injuries caused by falling trees/ branches		
Emission of greenhouse gases	Slippages caused by leaves, fruits	Cost to remove remains of pruning, debris, etc.	Disgust caused by plant litter or blocked views
	Reactions caused by agents supported by trees (caterpillars, birds,		





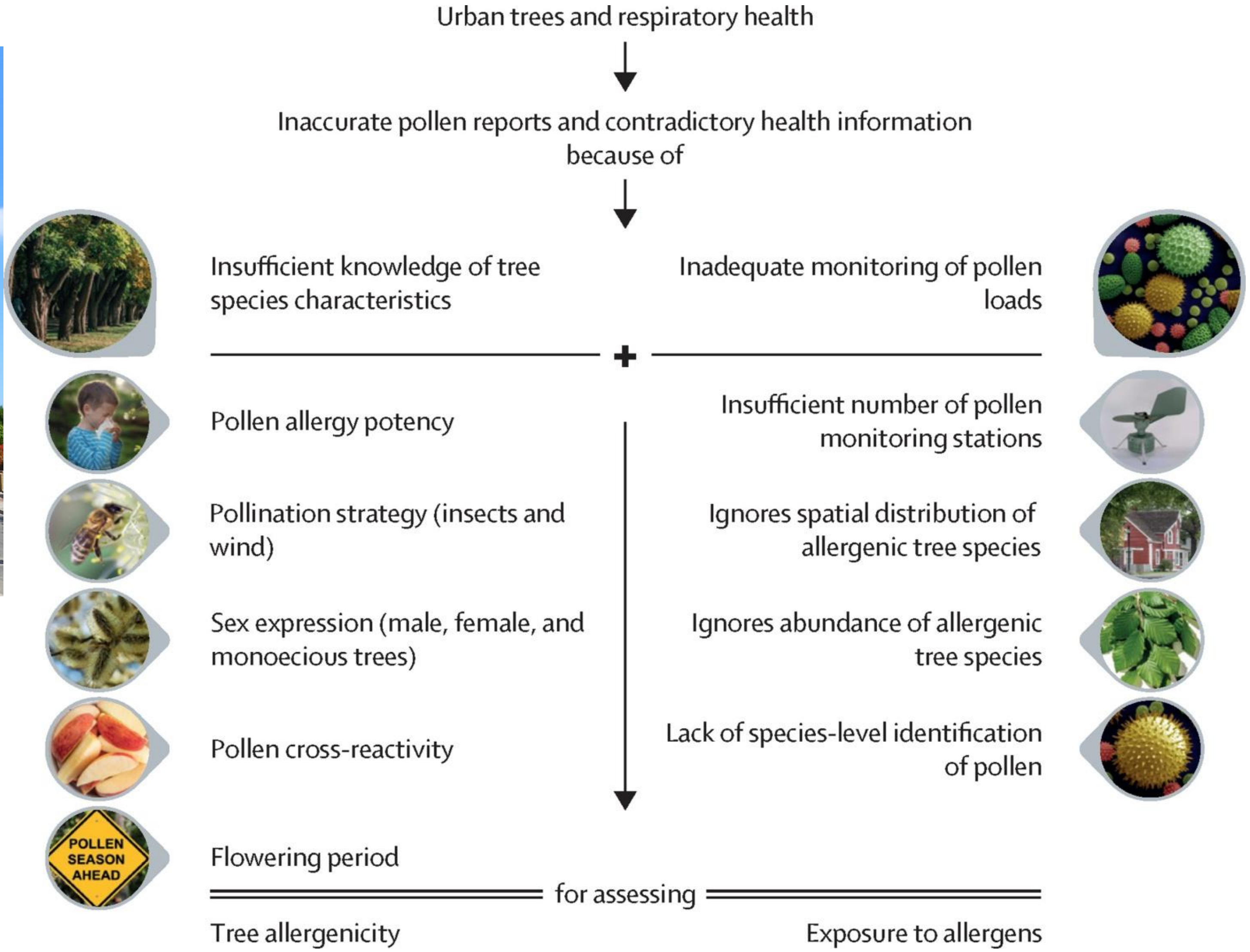
ECOSYSTEM FUNCTIONS	DISSERVICE	EXAMPLES	REFERENCES
Photosynthesis	Air quality problems	City tree and bush species emit volatile organic compounds (VOCs)	Chaparro and Terradas (2009); Geron et al (1994)
Tree growth through biomass formation	View blockage	Blockage of views by trees standing close to buildings	Lyytimäki et al. (2008)
Movement of floral gametes	Allergies	Wind-pollinated plants causing allergic reactions	D'Amato (2000)
Aging of vegetation	Accidents	Break up of branches falling in roads and trees	Lyytimäki et al. (2008)
Dense vegetation development	Fear and stress	Dark green areas perceived as unsafe in nighttime	Bixler and Floyd (1997)
Biomass fixation in roots; decomposition	Damages in infrastructure	Breaking up of pavements by roots; microbial activity	Lyytimäki and Sipila (2009)
Habitat provision for animal species	Habitat competition with humans	Animals/insects felt as scary, unpleasant, disgusting	Bixler and Floyd (1997)

2nd World Forum on Urban Forests
Washington DC, 2023

CAUSES OF THE GROWING ALLERGENICITY OF URBAN FORESTS

Exactly what do we know about tree pollen allergenicity?

Sousa-Silva et al., 2020. The Lancet Respiratory Medicine 2020 8DOI: (10.1016/S2213-2600(19)30472-2



CAUSES OF THE GROWING ALLERGENICITY OF URBAN FORESTS


Landscape and Urban Planning 101 (2011) 205–214

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

ELSEVIER

Review

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

Paloma Cariñanos*, Manuel Casares-Porcel

Department of Botany, Faculty of Pharmacy, Campus de Cartuja, University of Granada, 18071 Granada, Spain

LOW BIODIVERSITY

BOTANICAL SEXISM

CAUSES OF THE GROWING ALLERGENICITY:

- LOSS OF BIODIVERSITY
- BOTANICAL SEXISM
- INTRODUCTION OF ALLOCHTHONOUS SPECIES
- SPREAD OF INVASIVE SPECIES
- ENVIRONMENTAL DEGRADATION
- CLIMATE CHANGE
- ATMOSPHERIC POLLUTION
- BIOTIC HOMOGENIZATION
- PROXIMITY TO ALLERGEN SOURCES OF EMISSION
- DECISIONS MADE SEVERAL DECADES AGO

INTRODUCTION EXOTICS

SPREAD OF INVADERS

MOLECULAR CROSS-REACTIONS

CAUSES OF THE GROWING ALLERGENICITY OF URBAN FORESTS

GLOBAL ATLAS OF ALLERGY. EAACI. 2014

Figure 1 Word maps showing the distribution of trees causing respiratory allergic reactions. Representative members of the Fagales family (Betula and Quercus), the Oleaceae family (Olea and Fraxinus), and the Cupressaceae family (Cryptomeria and Juniperus) are depicted in the maps as density of registered data (increasing density from yellow to orange) within the Global Biodiversity Information Facility (www.gbif.org), a free and open access data infrastructure funded by governments.

The Global Urban Tree Inventory: A database of the diverse tree flora that inhabits the world's cities (Ossola et al., 2020. Glob. Ecol. Biog. 11, 1907-14)

Ginkgo biloba
Gleditsia triacanthos
Acer negundo
Acer platanoides
Acer rubrum
Pyrus calleryana
Quercus rubra
Prunus cerasifera
Acer saccharinum
Tilia cordata
Morus alba
Quercus palustris
Liquidambar styraciflua
Liriodendron tulipifera
Acer saccharum
Fraxinus americana
Acer palmatum
Quercus robur
Aesculus hippocastanum

URBAN SPECIES	
Urban tree species	4,734
Urban tree genera	1,272
Urban tree families	175
% of the known global tree flora	7.87%
Estimated urban tree species	8,532 ± 230

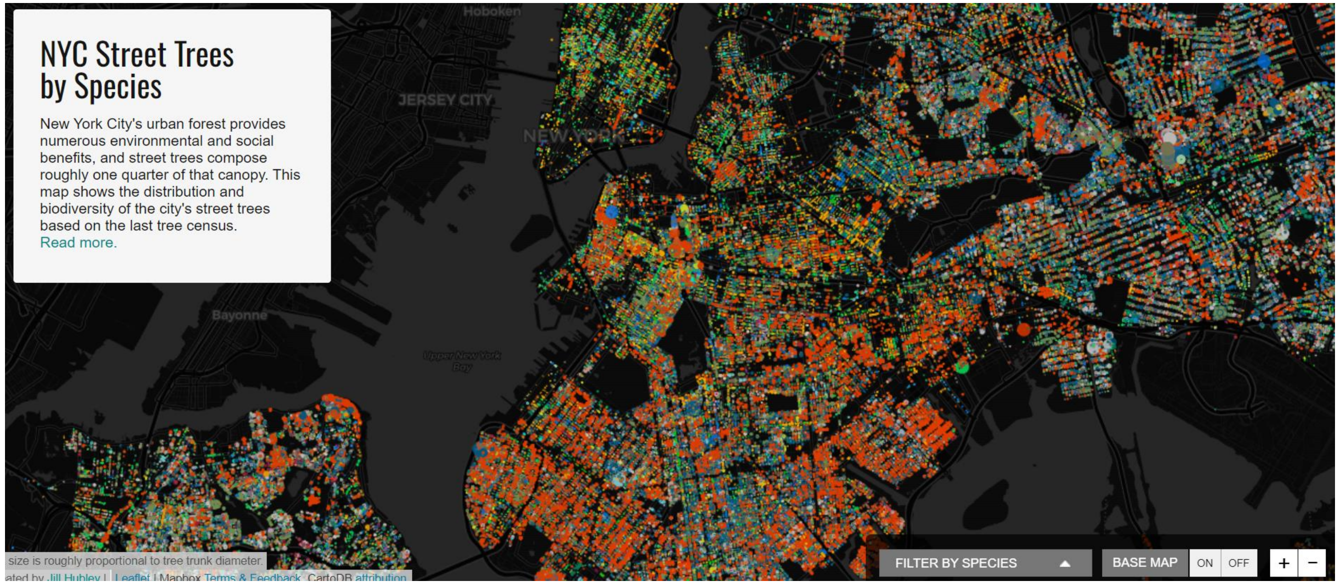
DECISSIONS MADE SEVERAL DECADES AGO

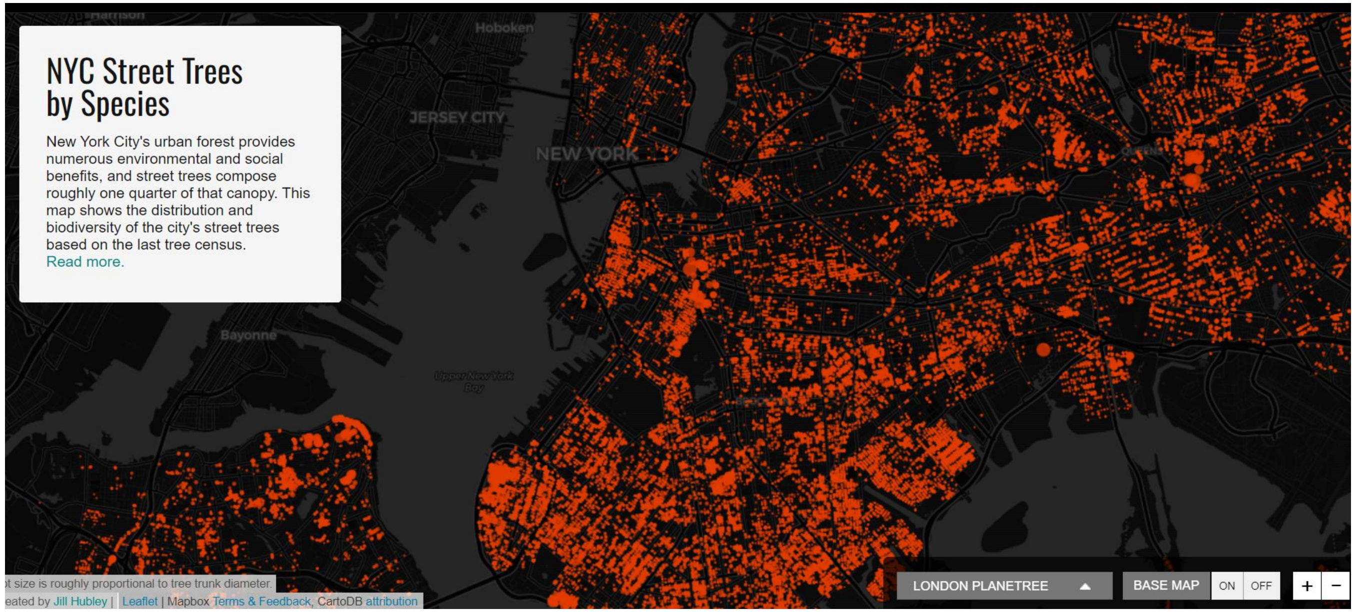
Plant Type Selection Criteria in Road Planting

Functional Criteria (C1)	Ecological Criteria (C2)	Economic Criteria (C3)	Structural Criteria (C4)	Visual Criteria (C5)
C11. Masking	C21. Soil requirements	C31. Cheap cost	C41. Ability to be pruned	C51. Leaf color
C12. Redirecting	C22. Climatic requirements	C32. Less care	C42. Fast development	C52. Flower color
C13. Noise blocking	C23. Resistance to air pollution	C33. Indigenous species reflecting urban identity	C43. Deep rooted	C53. Texture
C14. Providing pedestrian and vehicle safety	C24. Light requirements	C34. Longevity	C44. No root sprouts	C54. Form
C15. Road definition	C25. Wind resistance		C45. Shadow tree	C55. Dimension
C16. Creating a signal effect	C26. Resistance to insect pests and diseases		C46. Falling flower fruit seed etc.	C56. Calligraphy
C17. Increase urban green space	C27. Salt resistance		C47. Future size and diameter	C57. Continuity
C18. Air cleaning	C28. Harmony with the city			C58. Evergreen
C19. Wind control				C59. Deciduous
C110. Shadowing				C510. Road width
C111. Providing a living space for wildlife				C511. Planting ranges

ALLERGENICITY???

CASE 1: LONDON PLANE





CASE 1: LONDON PLANE

Platanus orientalis

X

Platanus occidentalis

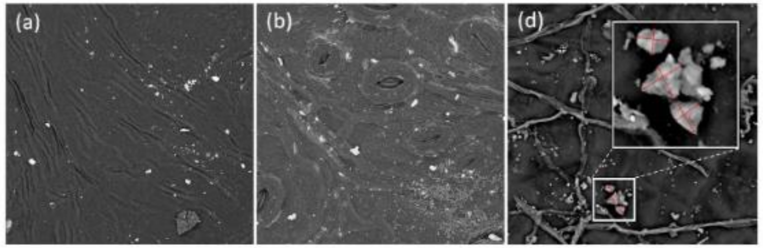
=

Platanus x hispanica

Morus alba	Arbol	05/10 cm. Ø	9,00 euros
		10/15 cm. Ø	13,00 euros
Morus nigra	Arbol	05/10 cm. Ø	9,00 euros
		10/15 cm. Ø	13,00 euros
Magnolia grandiflora	Arbol	50/100 cm. Alt.	12,00 euros
		100/150 cm. Alt	24,00 euros
Olea europaea	Arbol	25/50 cm. Alt	5,00 euros
		50/100cm. Alt	10,00 euros
Paulownia tomentosa	Arbol	10/15 cm. Ø	12,00 euros
		[illegible]	[illegible]
Platanus x hispanica	Arbol	05/10 cm. Ø	10,00 euros
		10/15 cm. Ø	14,00 euros
Platanus orientalis	Arbol	05/10 cm. Ø	12,00 euros
		10/15 cm. Ø	16,00 euros
Populus alba	Arbol	05/10 cm. Ø	9,00 euros
		10/15 cm. Ø	13,00 euros
Populus nigra	Arbol	05/10 mm Ø	9,00 euros
		10/15 cm. Ø	13,00 euros
Populus boleana	Arbol	05/10 cm. Ø	9,00 euros
		10/15 cm. Ø	13,00 euros
Populus simoni	Arbol	05/10 cm. Ø	9,00 euros
		10/15 cm. Ø	13,00 euros
Prunus cerasifera	Arbol	50/100 cm. Alt	5,00 euros
		100/150 cm. Alt	15,00 euros

BENEFITS OF LONDON PLANE

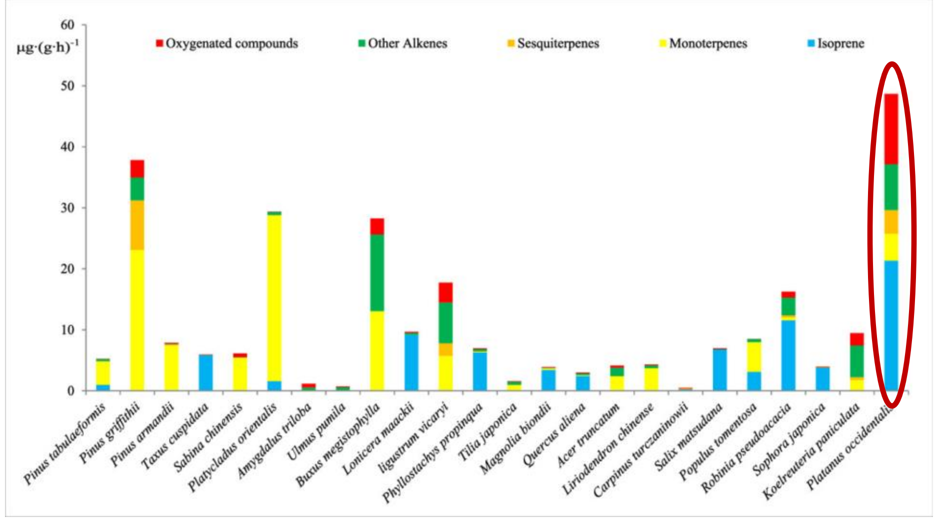
- Easily available in nurseries at an advantageous price
- Fast growing
- Good tolerance to urban microclimate conditions, soil compaction and air pollution
- Participate in pollution mitigation by accumulating PM in in its cortex and leaves
- Participate in the regulation of urban microclimate providing shade and moderating winds
- High phenotypic plasticity with resistance to frost and drought
- Supports pruning well, even intense



SEM images of the adaxial (a) and abaxial (b) surfaces of London-plane leave. Particulates PM3-10 deposited on surface (c). Baldachini et al., 2017.

CASE 1: LONDON PLANE

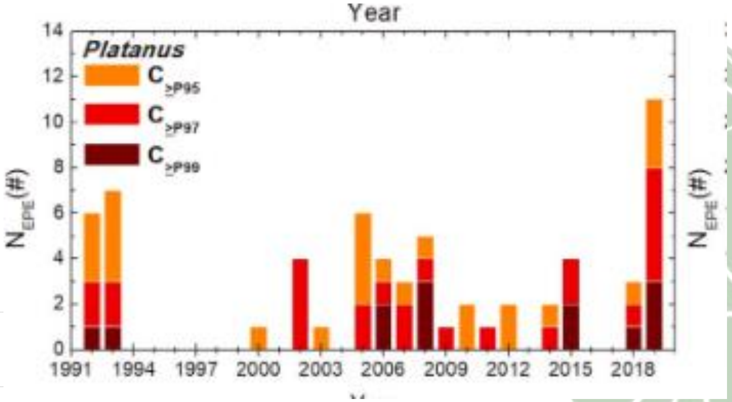
COSTS (DISSERVICES) OF LONDON PLANE



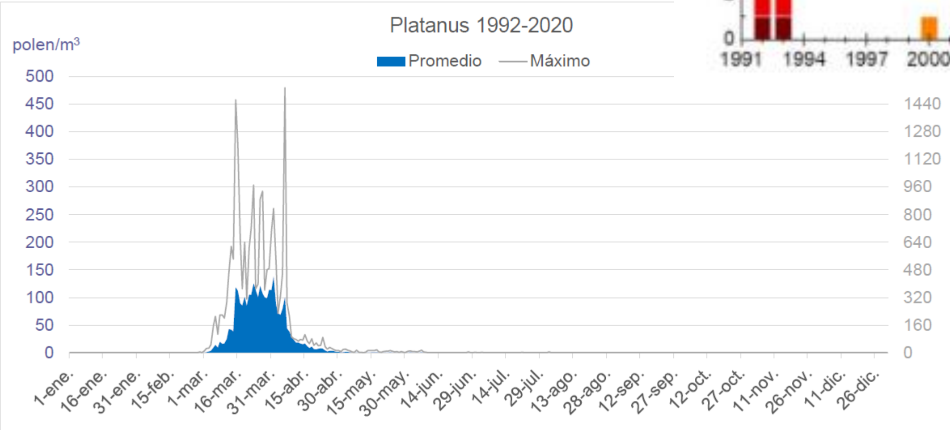
PRODUCTION OF HIGH AMOUNTS OF BVOCs

SUSCEPTIBILITY TO PESTS AND DISEASES

PRODUCTION OF HIGH AMOUNTS OF ORGANIC DEBRIS



DISTRIBUTION ON PLANE-TREE ALLERGENICITY IN THE WORLD



*Threshold of symptomatic response in sensitized people is 50 grains/m3
*More than 60% of affected popultaion in Madrid
*Cross-allergenicity with Olea, birch and grass pollen

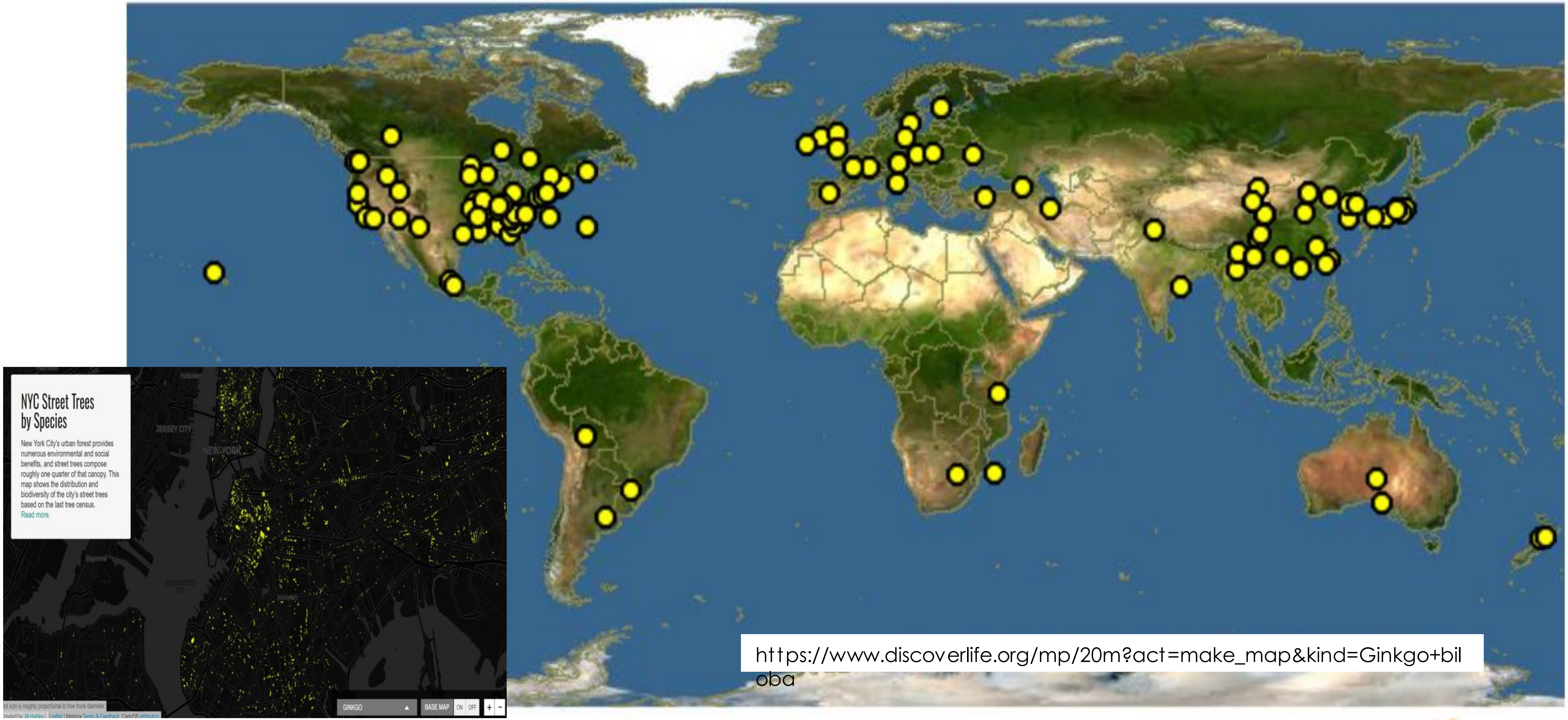
CASE 2: GINKGO BILOBA

GINKGO IN HORTUS BOTANICUS GRANADA, 1889

GINKGO IN HORTUS BOTANICUS LEIDEN, 1870

CASE 2: GINKGO BILOBA

Larger populations Ginkgo biloba in cities



https://www.discoverlife.org/mp/20m?act=make_map&kind=Ginkgo+biloba

2nd World Forum on Urban Forests
Washington DC, 2023

CASE 2: GINKGO BILOBA

Phenology and Aerobiology of the Maidenhair tree (*Ginkgo biloba*)

Cariñanos et al., 2013.

	PORTABL E	PERMANE NT
17/04	37	2
18/04	92	3
19/04	129	3
20/04	37	1
21/04	36	1
22/04	34	3
23/04	16	0
24/04	36	2

	PORTABL E	PERMANENT
31/03	113	
1/04	57	
2/04	236	2
3/04	168	0
8/04	1022	12
9/04	1116	9
10/04		10

	Pollen product/ anther	**Pollen product/ brachiblast**	**Pollen product/ branch**	**Pollen product/ tree**
2012	1.800 pollen grains	180 x 10^{3}	180 x 10^{4}	180 x 10^{6}
2013	13.852 pollen grains	138,52 x 10^{4}	138,52 x 10^{5}	1.385,2 x 10^{6}

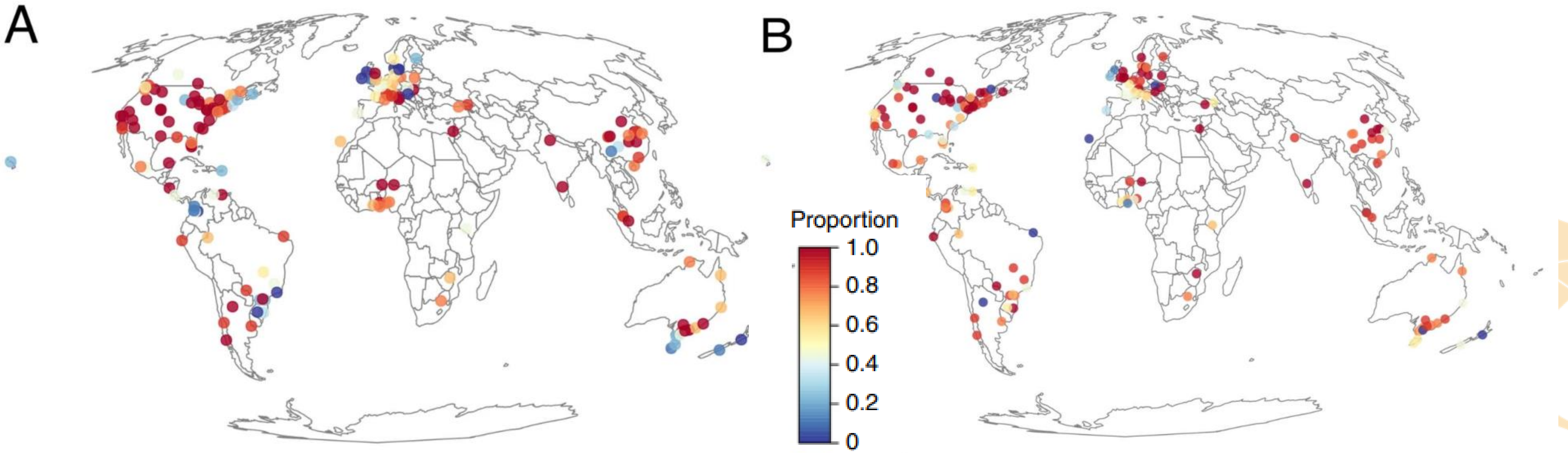
Yun YY, Ko SH, Park JW, Hong CS. 2000. **IgE immune response to Ginkgo biloba pollen.** Ann Allergy Asthma Immunol. 2000 Oct;85(4):298-302

The New Hope

MEASURES TO MINIMIZE THE IMPACT OF TREE ALLERGENICITY

Esperon-Rodriguez, *et al*. Climate change increases global risk to urban forests. *Nat. Clim. Chang.* **12**, 950–955 (2022). https://doi.org/10.1038/s41558-022-01465-8

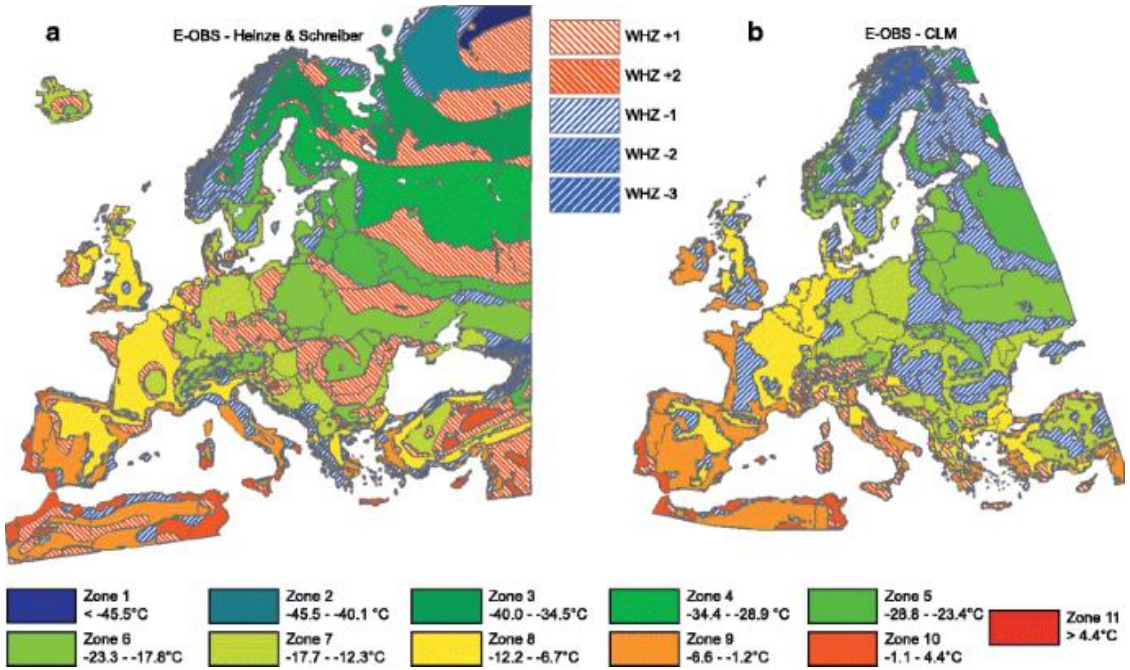
Assessment 3,129 tree and shrub species, using three metrics related to climate vulnerability: exposure, safety margin and risk.



Proportion of plant species predicted to be at risk of changes in maximum temperature of the warmest month (**A**), minimum temperature of the coldest month (**B**), and precipitation of the driest quarter

2nd World Forum on Urban Forests
Washington DC, 2023

MEASURES TO MINIMIZE THE IMPACT OF TREE ALLERGENICITY




ZONE 6


ZONE 7


ZONE 8

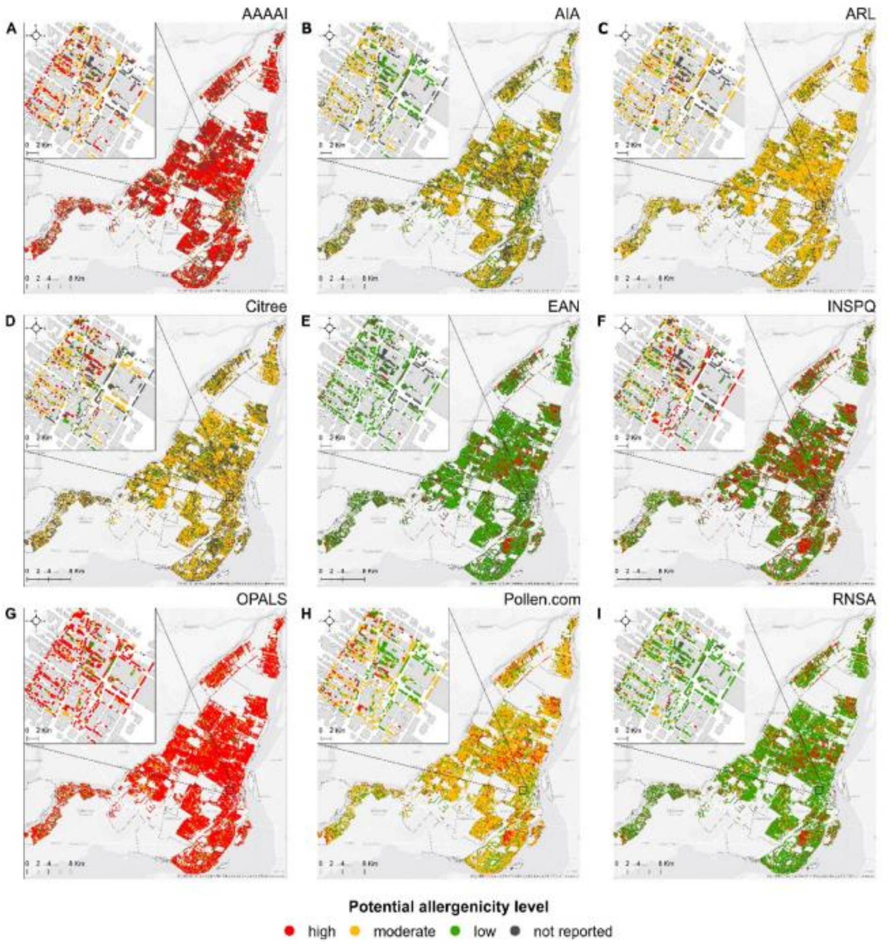

ZONE 9

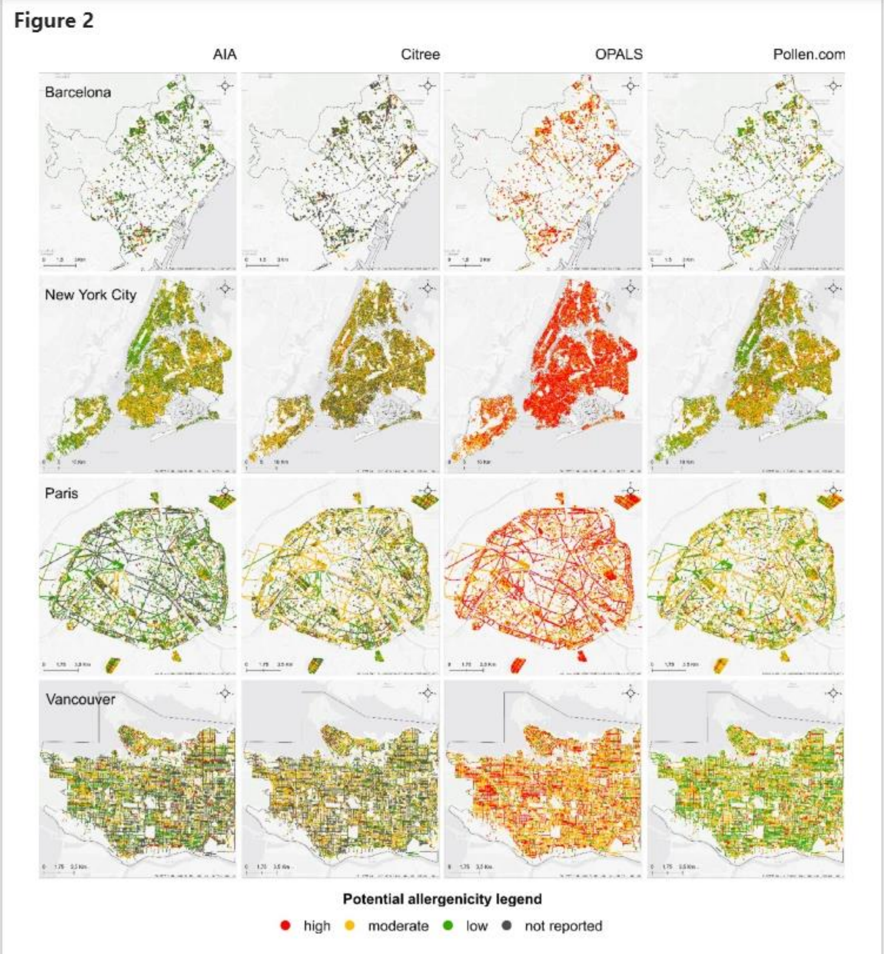

ZONE 10

2nd World Forum on Urban Forests
Washington DC, 2023

MEASURES TO MINIMIZE THE IMPACT OF TREE ALLERGENICITY

STRONG VARIATIONS IN URBAN ALLERGENICITY RISKCAPES DUE TO POOR KNOWLEDGE OF TREE POLLEN ALLERGENIC POTENTIAL (Sousa-Silva et al., 2021. Scientific Reports, 11:10196)





Figures 1 & 2. The allergenicity riskscape of the cities of Montreal (left) Barcelona, New York City, Paris, and Vancouver based on the potential pollen allergenicity of the public trees analyzed in each city using diferent tree allergenicity data sources. Each dot represents one tree, each row corresponds to a single city, and each column to a diferent tree allergenicity data source. Only the AIA-, Citree-, OPALS-, and Pollen.com-based riskscapes are shown for presentation clarity and because the four datasets contained the largest numbers of species for which allergenicity is reported (for more than 100 species).

VALUE OF POTENTIAL ALLERGENICITY (VPA)

IT IS A COMBINATION OF BIOLOGICAL, PHENOLOGICAL AND ALLERGENIC ATTRIBUTES THAT ALLOWS ASSIGNING AN ALLERGENIC CLASS TO EACH SPECIES

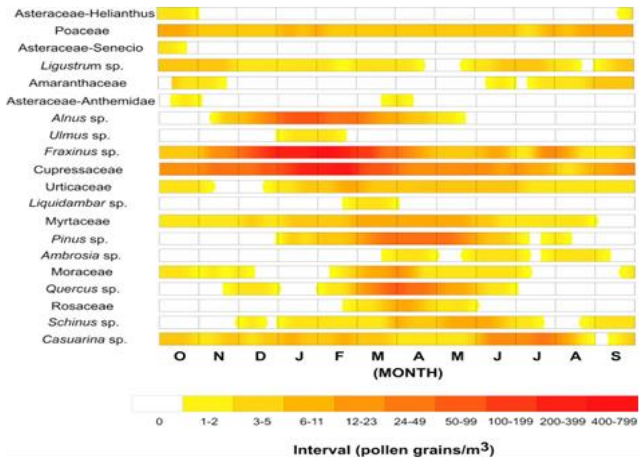
TYPE OF POLLINATION (TP)

WIND-POLLINATED SPECIES EMITT LARGE AMOUNTS OF POLLEN

PE	1= Entomophilous
	2= Anphiphilic
	3= Anemophilous

DURATION OF POLLINATION PERIOD (DPP)

THE MORE EXTENSIVE THE FLOWERING PERIOD, THE LONGER THERE IS POLLEN IN THE AIR



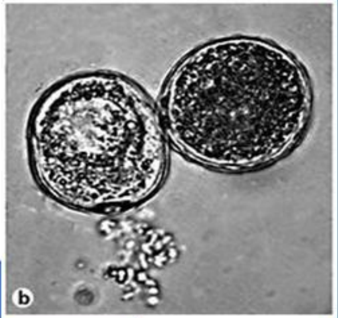
DPP	1= 1-3 weeks
	2= 4-6 weeks
	3= > 6 weeks

ALLERGENIC POTENTIAL (AP)

POLLEN GRAIN MAY BE INTRINSICALLY ALLERGENIC DUE TO THE EXISTENCE OF PROTEINS OR OTHER ORGANIC COMPOUNDS IN ITS EXTERNAL WALL

ALLERGOME

IUIS Immunology without Borders
International Union of Immunological Societies



AP	0= no allergenic
	1= low allergenicity
	2= moderate allergenicity
	3= high allergenicity
	4= very high allergenicity

VALUE OF POTENTIAL ALLERGENICITY (VPA)

VPA	Class of Allergenicity
0	Nil
1-6	Low
8-12	Moderate
16-24	High
27-36	Very High

Prunus spp.

Pollination strategy : 1
Duration of pollination period: 1
Allergenic potencial: 1

VPA: 1
LOW ALLERGENICITY

Celtis australis

Pollination strategy : 3
Duration of pollination period: 2
Allergenic potencial: 2

VPA: 12
MODERATE ALLERGENICITY

Platanus x hispanica

Pollination strategy : 3
Duration of pollination period: 2
Allergenic potencial: 3

VPA: 18
HIGH ALLERGENICITY

Cupressus sempervirens

Pollination strategy : 3
Duration of pollination period: 3
Allergenic potencial: 3

VPA: 27
VERY HIGH ALLERGENICITY

MEASURES TO MINIMIZE THE IMPACT OF TREE ALLERGENICITY

SPECIES	VPA*
Acer negundo	18
Aesculus hippocastanum	12
Alnus glutinosa	18
Betula spp.	27
Broussonetia papyrifera	27
Carpinus betulus	27
Casuarina equisetifolia	27
Cupressus arizonica; C. sempervirens	27
Cupressocyparis leylandii	27
Fraxinus spp.	18
Ligustrum japonicum	12
Morus alba; M. nigra	27
Olea europaea	18
Platanus hispanica	18
Populus alba; P. nigra	18
Quercus spp.	18
Ulmus minor	18


Urban Forestry & Urban Greening 63 (2021) 127218
Contents lists available at ScienceDirect
Urban Forestry & Urban Greening
journal homepage: www.elsevier.com/locate/ufug
ELSEVIER

An updated proposal of the Potential Allergenicity of 150 ornamental Trees and shrubs in Mediterranean Cities

Paloma Cariñanos[a,b,*], Francesca Marinangeli[c]

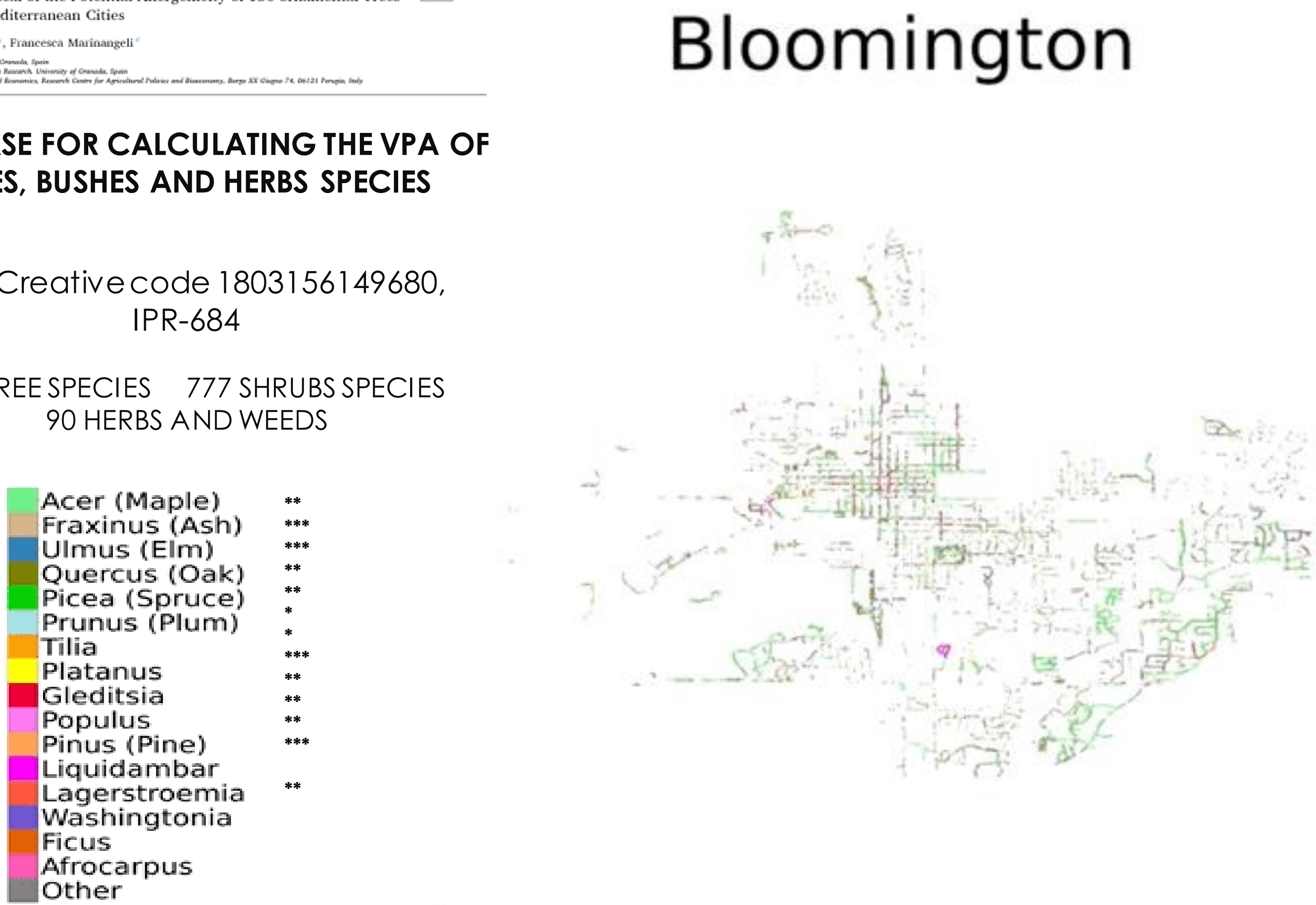
[a] Department of Botany, University of Granada, Spain
[b] Andalusian Institute for Earth System Research, University of Granada, Spain
[c] Council for Agricultural Research and Economics, Research Centre for Agricultural Policies and Bioeconomy, Borgo XX Giugno 74, 06121 Perugia, Italy

DATABASE FOR CALCULATING THE VPA OF TREES, BUSHES AND HERBS SPECIES

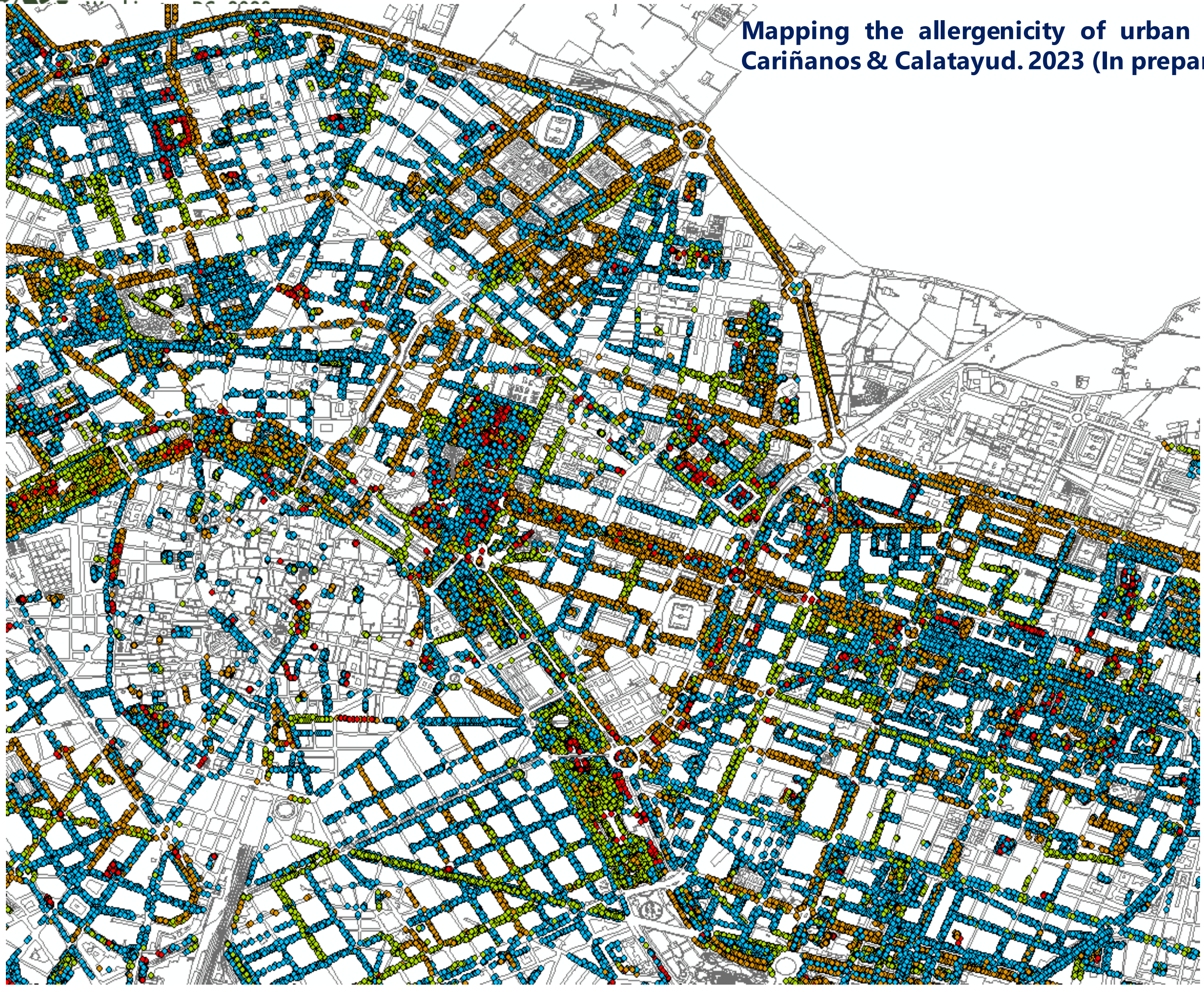
SafeCreative code 1803156149680, IPR-684

500 TREE SPECIES 777 SHRUBS SPECIES
90 HERBS AND WEEDS

The Auto Arborist Dataset
https://google.github.io/auto-arborist/
Beery et al., 2022.



MEASURES TO MINIMIZE THE IMPACT OF TREE ALLERGENICITY



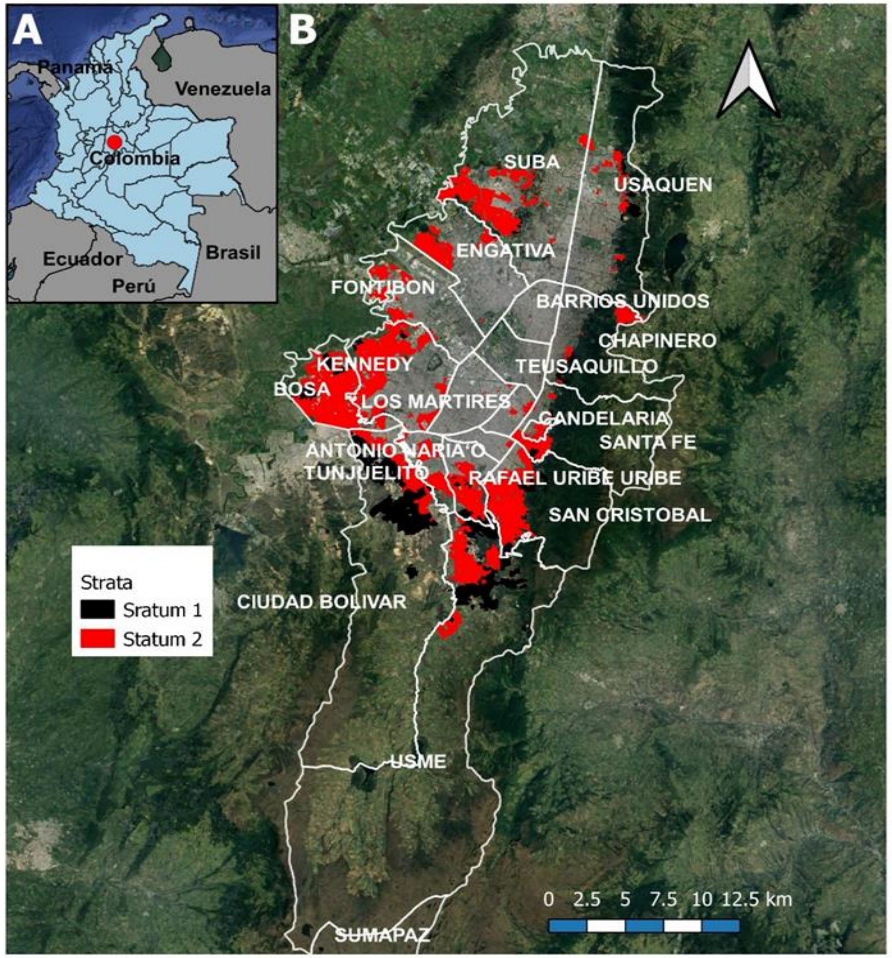
Mapping the allergenicity of urban trees and urban parks in the city of Valencia (Spain). Cariñanos & Calatayud. 2023 (In preparation).

Citrus aurantium

Platanus x hispanica

Cupressus spp.

MEASURES TO MINIMIZE THE IMPACT OF TREE ALLERGENICITY



Neotropical urban forest allergenicity and ecosystem disservices can affect vulnerable neighborhoods in Bogota, Colombia. 2022. Francisco J Escobedo[1], Cynnamon Dobbs[2], Yuli Tovar[3] Paloma Cariñanos. Sustainable Cities and Society. In press.

Genero - especie	Alergenicidad
Abatia parviflora	NA
Abelia grandiflora x chinensis	Moderada
Abutilon x hibridon	NA
Abutilon insigne	NA
Acacia baileyana ssp. Purpurea	Alta
Acacia cultriformis	Alta
Acacia decurrens	Moderada
Acacia melanoxylon	Moderada
Acca sellowiana	Alta
Agonis flexuosa	NA
Alchornea bogolensis	NA
Alnus acuminata	Alta
Aloysia triphylla	NA
Althaea officinalis	Baja
Amphitecna latifolia	NA
Anacardium occidentale	Alta
Annona cherimola	Baja
Annona squamosa	Baja
Araucaria araucana	Alta
Araucaria excelsa	Alta
Archontophoenix alexandrae	Moderada
Archontophoenix cunninghamiana	Moderada
Axinaea macrophylla	NA
Azadirachta indica	Moderada
Baccharis macrantha	Alta
Baccharis glutinosa	Alta
Bahuinia forficata	NA
Bellucia axianthera	NA
Berberis vulgaris	Baja
Billia rosea	NA
Bocconia frutescens	NA
Brownea ariza	NA
Brugmansia x candida	Baja
Brunfelsia pauciflora	NA
Budleja davidii	Baja
Bulnesia arborea	NA
Bursera simaruba	Moderada
Buxus sempervirens	Moderada
Caesalpinia spinosa	NA
Calliandra schultzei	Moderada
Calliandra inequilatera	Moderada
Calliandra magdalenae	Moderada
Calliandra pittier	Moderada
Calliandra trinerva	Moderada
Calistemum spp.	Alta
Calycolpus moritzianus	NA
Calycophyllum multiflorum	NA
Camelia japonica	NA
Capparis odoratissima	NA
Cariniana pyriformis	NA
Carica pubescens	Baja
Casuarina equisetifolia	Alta
Cassia grandis	NA
Cavendistria cordifolia	NA
Cecropia angustifolia	Alta
Cecropia peltata	Alta
Cedrela odorata	Baja
Cedrela montana	NA
Ceiba pentandra	Baja
Ceroxylon quinduense	Alta
Cestrum nocturnum	NA
Chamaecyparis lawsoniana	Alta
Chlorophytum comosum	NA
Citharexylon subflavescens	Moderada
Citrus spp.	Moderada
Clusia multiflora	NA
Clusia insignis	NA
Coffea arabica	NA
Coleonema album	NA
Cordia cylindrostachya	Baja
Cordia sebestena	Baja
Cordyline australis	Baja
Corymbia maculata	Alta
Cotoneaster multiflora	NA
Crescentia crujete	NA
Croton spp.	Alta
Cryptomeria japonica	Alta
Cupressus lusitanica	Alta
Cupressus sempervirens	Alta
Cyathea caracasana	NA
Cycas revoluta	Alta
Dalea coerulea	NA
Diaphnopsis caracasana	NA
Delostoma integrifolia	NA
Dendropanax arboreus	NA
Diplostephium rosmarinifolius	NA
Dodonaea viscosa	Alta
Duranta mutsilii	NA
Elaeis oleifera	Alta
Escallonia myrtilloides	NA
Eucalyptus filicifolia	Moderada
Eucalyptus globulus	Moderada
Ficus benjamina	NA
Ficus carica	NA
Ficus elastica	NA
Ficus soatensis	NA
Ficus tequendama	NA
Fraxinus chinensis	Alta
Fucshia arborea	NA
Fucshia magellanica	NA
Gardenia jazminoides	NA
Genipa americana	NA
Gliricidia sepium	NA
Grevillea robusta	Baja
Guadua angustifolia	Alta
Guazuma ulmifolia	NA
Guaiacum sanctum	NA
Handroanthus chrysanthus	NA
Haematoxylon brasiletto	NA
Hedyosmum spp.	NA
Heliocarpus americanus	NA
Hesperomeles goudoliana	NA
Hevea brasiliensis	Alta
Hibiscus sinensis	Baja
Hypericum perforatum	NA
Hyeronima colombiana	NA
Inga edulis	NA
Inga fendleriana	NA
Inga spuria	NA
Iochroma fuchsioides	Baja

CONCLUSIONS

THE **GREENING** THAT MANY CITIES ARE CARRYING OUT AS A NATURE-BASED SOLUTION TO FACE THE IMPACTS OF CLIMATE CHANGE, THE **NEW SPECIES** THAT WILL REPLACE THE CURRENT FORMERS OF URBAN FORESTS, AND ABOVE ALL, THE **CONSIDERATION OF ALLERGENICITY** AS A CRITERION OF SELECTION OF URBAN TREES REPRESENT AN OPPORTUNITY TO MITIGATE WRONG ALLERGENIC DECISIONS MADE SEVERAL DECADES AGO

Thank you

Paloma Cariñanos | University of Granada

palomacg@ugr.es

ACKNOWLEDGEMENTS: **Working Group on Urban Aerobiology, Spanish Association of Aerobiology; Silva Mediterranean WG on Urban and PeriUrban Forestry; Spanish Associations of Public Parks and Gardens;**

This research was funded by University of Granada through Pre-competitive Research Projects Own Plan, PP2022.PP.34, Pre-GREENMITIGATION3

2nd World Forum on Urban Forests

2023

World Forum on Urban Forests

2nd World Forum on Urban Forests

Washington DC, 2023

Serena Sofia, Donato Salvatore La Mela Veca, Alessio Santosuosso, Marco Perrino, Antonio Motisi, Rosario Schicchi, Giovanna Sala

The potential of the Handheld Mobile Laser Scanner (HMLS) tool in urban forest planning to design canopy consolidation interventions

Presented by

Dr. Serena Sofia

Department of Agricultural, Food and Forest Sciences

University of Palermo (Italy)

UNIVERSITÀ DEGLI STUDI DI PALERMO

D.R.E.AM. ITALIA

SAAF DIPARTIMENTO SCIENZE AGRARIE ALIMENTARI FORESTALI

SISTEMA MUSEALE DI ATENEO

46 of Monumental trees in Palermo city

⬇

12 of *Ficus macrophylla* subsp. *columnaris* in historical gardens

AIM OF THE STUDY

The use of innovative terrestrial LIDAR technologies to support the collection of preliminary data necessary to design a consolidation of the monumental trees canopy

EXPERIMENTAL SET-UP

A) Extrapolation of basic dimensional attributes of tree

1- Identification of *Ficus macrophylla* subsp. *columnaris* in the historic gardens of Palermo,

2- LIDAR data collection in field,

3- LIDAR Data processing and restitution of tree digital model.

B) Analysis of the structural tree canopy stability

1-Inspection of the tree branching structure,

2-Load assessment on the tree,

3-Identification of vulnerable crown branches in the tree.

C) Design of bracing/cabling schemes for tree consolidation

Location of trees

1-Botanical Garden, University of Palermo

CITY: PALERMO, ITALY

Average annual temperature:
12.2 °C (February) - 36.8 °C (August)
Precipitation: 615 mm for year
Soil: platform and deep-sea carbonates of Triassic-Oligocene age from Oligo-Miocene terrigenous deposits.

2- Garibaldi Garden

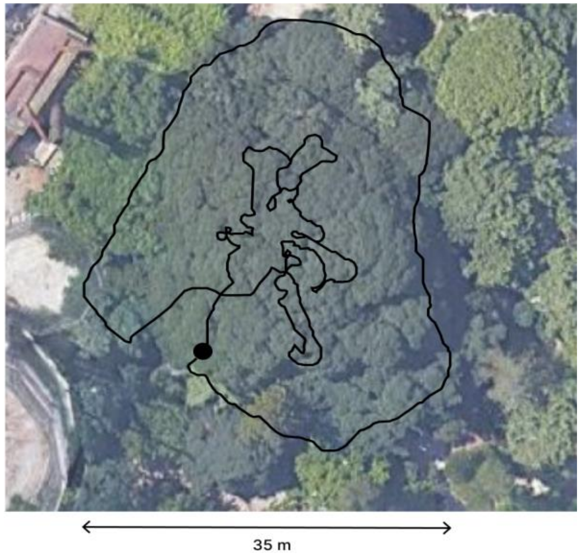
MATERIALS

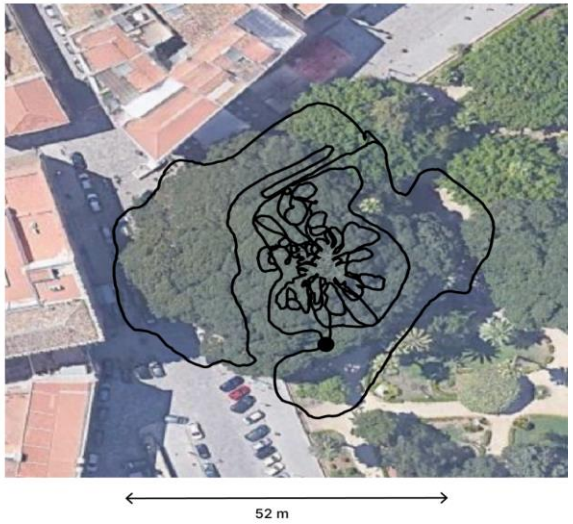
GEOSLAM ZEB HORIZON ™

- Lightweight hand-held mobile laser scanner with compact designe (HMLS)
- 300,000 measurements per second and 100 m of max laser beam
- with a Simultaneous Localization and Mapping (SLAM) technology

Lidar data: LIDAR point cloud with format .las/.laz

HMLS walking path scheme





LIDAR data processing Workflow

Input data:

LIDAR point cloud

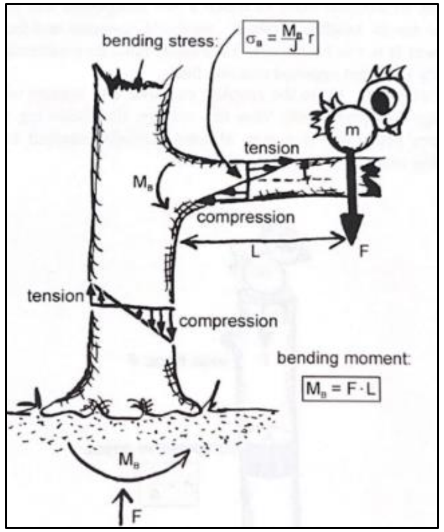
Software tools used:
-GeoSlam Hub 6.2,
-LIDAR360,
-TREESQM (MatLab package)

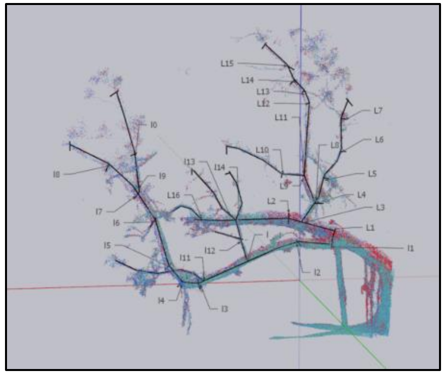
1-LIDAR PRE-PROCESSING

- Removal outliers and Filtering of ground points
- Removing the impact of terrain from Laser point Cloud.

2-EXTRACTION OF DIMENSIONAL TREE ATTRIBUTES

- Measuring of Stems Diameter, Height, Canopy Surface
- Restitution of the Tree Digital Model and measuring of Canopy and Stem Volume
- Calculation of total Bending Stress Load





3- IDENTIFICATION OF VULNERABLE CROWN BRANCHES

(Reyes,1992; Mattheck and Breloer, 1998; Niclas et al., 2014; Sani L., 2017; De Tanago *et al.* 2018, Petri et al., 2019; Dahle et al., 2019; Ducup *et al.* 2021; Pérez-Martín E. et al., 2021; Bessa et al., 2022)

Results of phase-A: Dimensional attributes of trees

1° FICUS TREE: Botanical Garden

2° FICUS TREE: Garibaldi Garden

Dimensional Parameters	**1°**	**2°**
Height (m)	29	32
Crown Base Height (m)	10.7	12.1
Canopy Surface (m^2)	2390	1980
Total Volume (m^3)	18866	26388
Total number of prop roots	137	219
Density (n. prop roots/canopy surface)	0.05	0.11
Total number of branches	12	14

Results of phase-B: Analysis of the structural tree canopy stability

1° FICUS TREE: Botanical Garden

Red: Branch 10
Green: Branch 11
(LIDAR360 software image)

ID Branch	1	2	3	4	5	6	7	8	9	10	11	12
Volume (m^3)	11	5.5	9	5.2	5.4	3.9	0.7	24	24	31	8	7
Mean insertion angle (°)	41	39	49	49	26	61	30	44	48	12	16	47
Surface area (m^2)	48	22	45	25	9.8	27	3.4	44	61	82	25	16
N. prop roots	6	7	13	2	0	4	1	6	16	1	0	0
Length of 1st order axis (m)	3.9	4.9	5	4	2	2.8	3.8	6.1	1.9	2.2	0.9	14
Basal Diameter of 1st order axis (m)	0.7	0.5	0.5	0.6	0.8	0.7	0.3	1	0.7	1	0.9	0.9
BENDING STRESS (σ) LOAD TOTAL VALUES	**0.6**	0.1	0.3	0.2	0.4	**0.5**	0.2	0.5	**1.9**	**1.3**	0.4	0.2

Results of phase-B: Analysis of the structural tree canopy stability

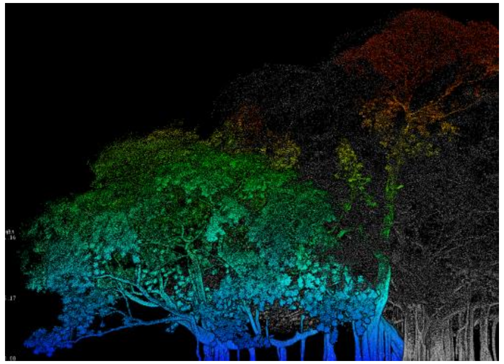
2° FICUS TREE: Garibaldi Garden

ID Branch	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Volume (m^3)	2	27	2	10	3	13	4	7	9	12	9	8	10	1
Mean insertion angle (°)	15	63	55	56	56	39	48	25	41	19	5	7	37	32
Surface area (m^2)	10	12	12	25	14	42	9	42	35	26	63	22	39	7
n. prop-roots	2	3	4	6	1	3	1	1	4	1	0	0	3	2
Length of 1st order axis (m)	2.0	3.3	4.3	3.7	3.2	2.6	2.7	3.4	3.9	1.7	3.8	2.8	2.2	3.4
Basal Diameter of 1st order axis (m)	0.4	1.3	0.4	0.5	0.5	0.6	0.9	0.7	0.6	1.1	0.9	0.8	1.0	0.5
BENDING STRESS (σ) LOAD TOTAL VALUES	0.01	**0.83**	0.05	**1.16**	0.15	**0.87**	0.25	0.22	0.37	0.13	0.24	0.36	**1.21**	0.19

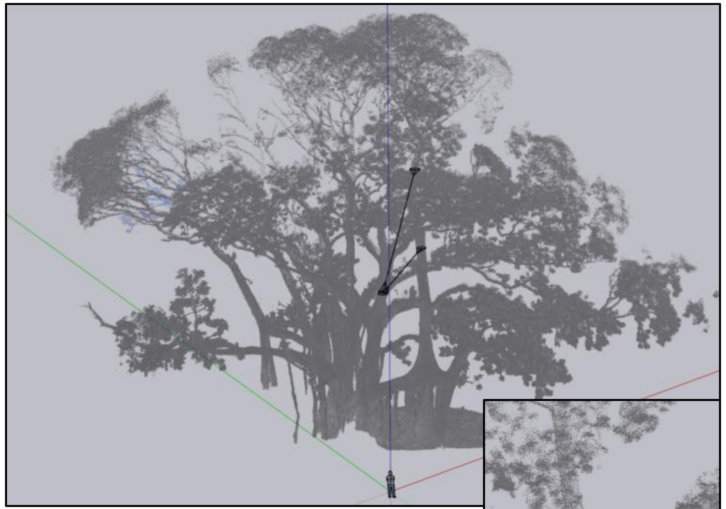
Red: ID Branch 4
Green: ID Branch 3
(LIDAR360 software image)

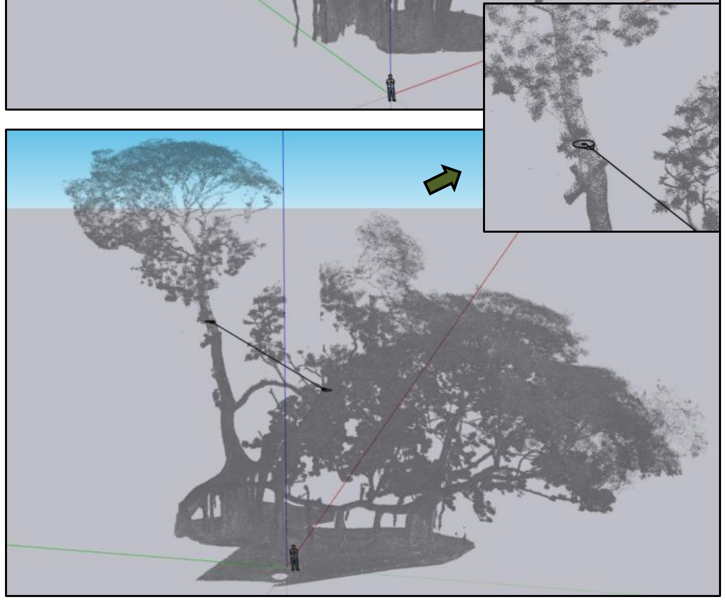
Results of phase-C: Consolidation drawings for certain branches of a tree's canopy.

1° FICUS TREE: Botanical Garden



Installation map:





Branch ID 9

Three consolidations

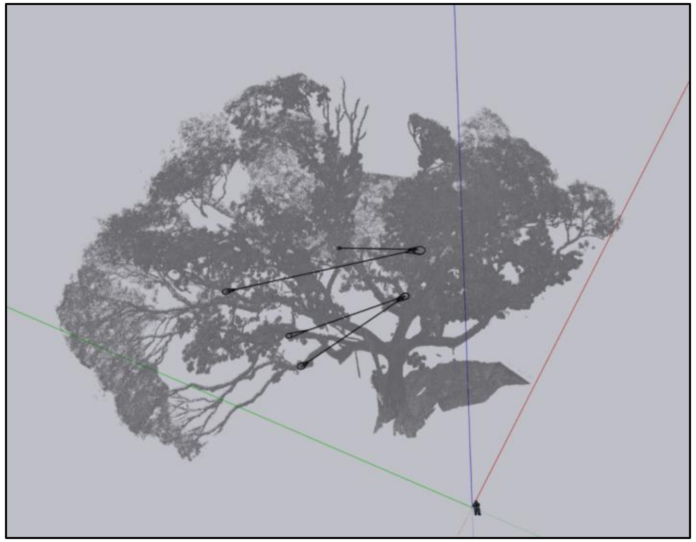
Type of consolidation:
Two tethering system with a high-strength (8 MN, 27.55 m)

One tethering system with a medium-strength (4 MN, 17.18 m)

Material specification:
Polypropylene, elongation about 5%

Anchoring points:
Near main branch

Installation map:



Branch ID 10

Four Consolidations

Type of Consolidation:
Two tethering system with a low-strength (2 MN, 27.76 m)

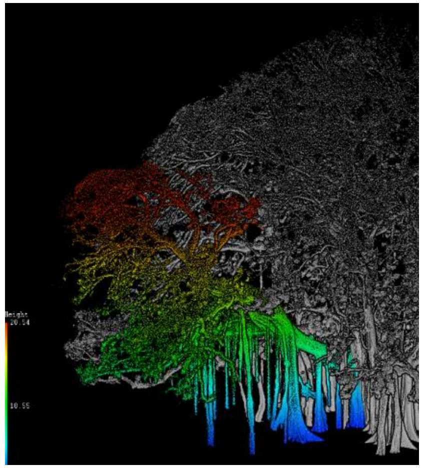
Two tethering system with a medium- strength (4 MN, 36.48 m)

Material specification:
Polypropylene, elongation about 5%

Anchoring points:
Near main branch

Results of phase-C: Consolidation drawings for certain branches of a tree's canopy

2° FICUS TREE: Garibaldi Garden



Branch ID 4

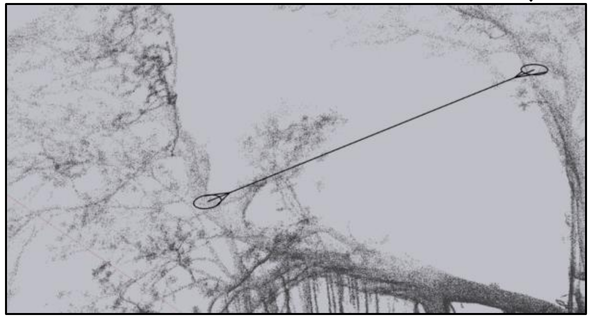
One Consolidation

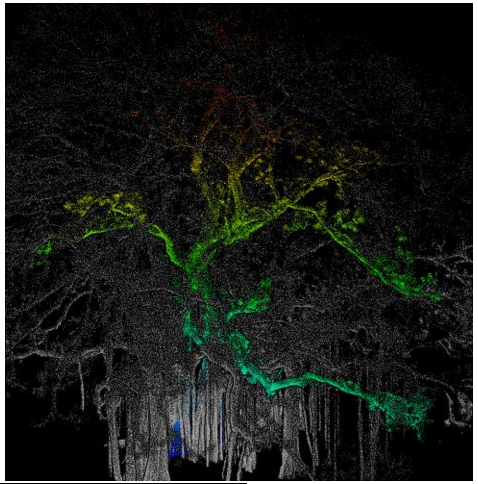
Type of Consolidation:
One tethering system with a high-strength (8 MN, 20.00 m)

Material specification:
Polypropylene, elongation about 5%

Anchoring points:
Near main branch

Installation map:





Branch ID 13

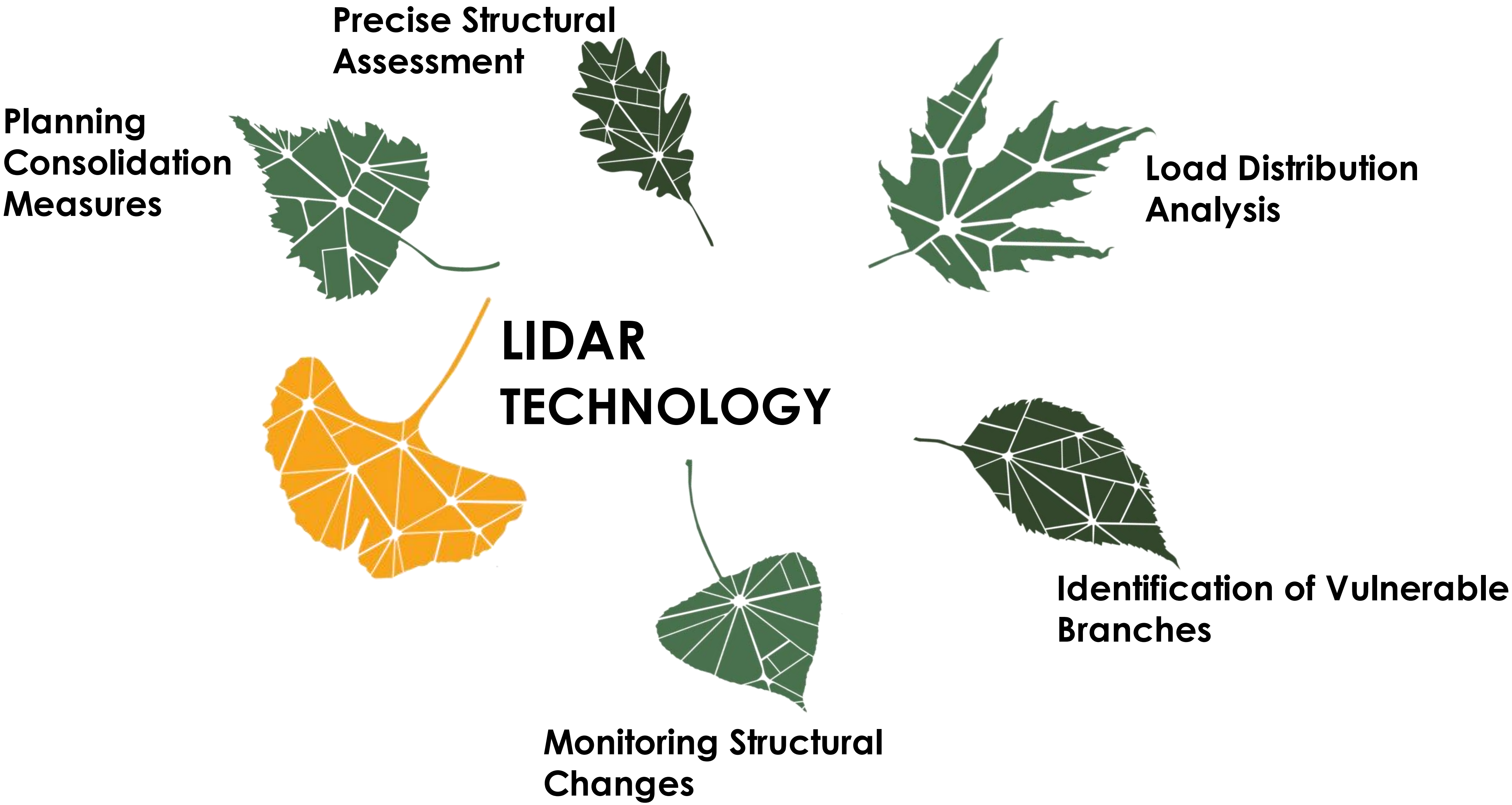
One Consolidation

Type of Consolidation:
One tethering system with a medium-strength (4 MN, 22.50 m)

Material specification:
Polypropylene, elongation about 5%

Anchoring points:
Near main branch

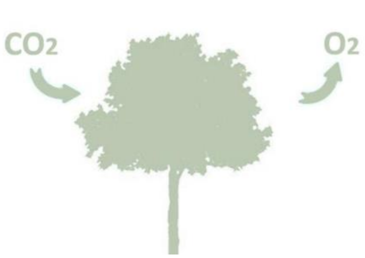
Installation map:

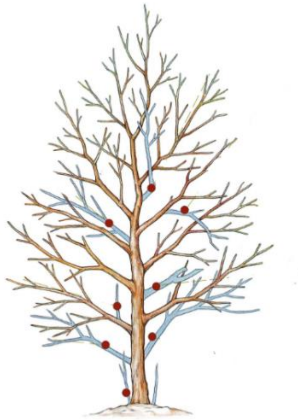

Precise Structural Assessment
Planning Consolidation Measures
Load Distribution Analysis
LIDAR TECHNOLOGY
Identification of Vulnerable Branches
Monitoring Structural Changes

Conclusion and Implications

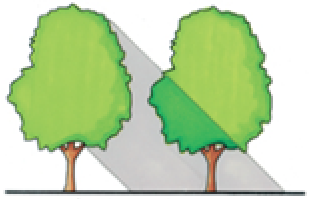
- Innovative technology plays a **significant role** in the intervention of consolidation for trees
- Identification and treatment of vulnerable branches mitigate **the risks associated with tree failure in extreme weather conditions**
- Consolidation benefits for preserving **historic trees** and tree habitats
- Consolidation supports **sustainable urban planning** by integrating existing trees into new developments

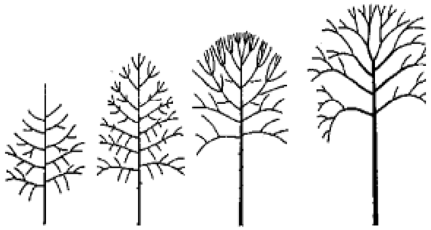
Future researches





- Evaluation of carbon stoc
- Simulations of pruning interventions
- Analysis of the size of shaded space and current dimensional developme…





Thank you

Serena Sofia | University of Palermo

serena.sofia@unipa.it

Food and Agriculture Organization of the United Nations · Arbor Day Foundation · d. · POLITECNICO MILANO 1863 · SISEF · ISA · Smithsonian · Forest Service U.S. Department of Agriculture

2nd World Forum on Urban Forests

2023

World Forum on Urban Forests

2nd World Forum on Urban Forests

Washington DC, 2023

Wildfire alters the spatial and temporal dynamics of urban forest ecosystem services and disservices in California, USA

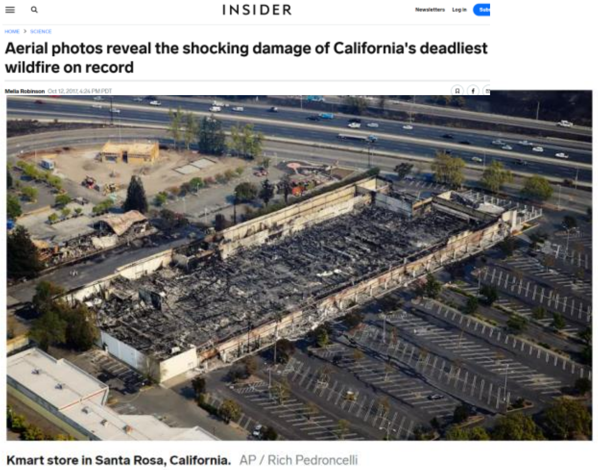
Presented by

Francisco J Escobedo

USDA Forest Service Pacific Southwest Research Station

Los Angeles Urban Center

Wildfire are affecting urban areas

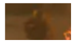


Communities are also being affected

LA NACION > El Mundo

Desigualdad: los contrastes sociales de Chile que provocaron el incendio

Racial and ethnic minorities are more vulnerable to wildfires



Wealthier, Whiter Areas Are More Likely to Get Help After Fires, Data Show

Minorities Are Most Vulnerable When Wildfires Strike in U.S., Study Finds

Chester Hopkins picked through the rubble of his Lincoln Heights home, which he owned for 40 years before it burned in the fire. Brian L. Frank for The New York Times

News // California Wildfires

Historic Black Northern California neighborhood destroyed in Mill Fire

Sam Moore, SFGATE

Sep. 3, 2022

A tale of two wildfires: devastation highlights California's stark divide

Larger and more Severe Wildfires in California

- "*Wildfire risk to Communities*" based on, "…building centroid point file from individual Microsoft building footprint polygons (n = 25 million; Microsoft, 2018) … to tabulate the total number of buildings within each perimeter" (Ager et al., 2021.

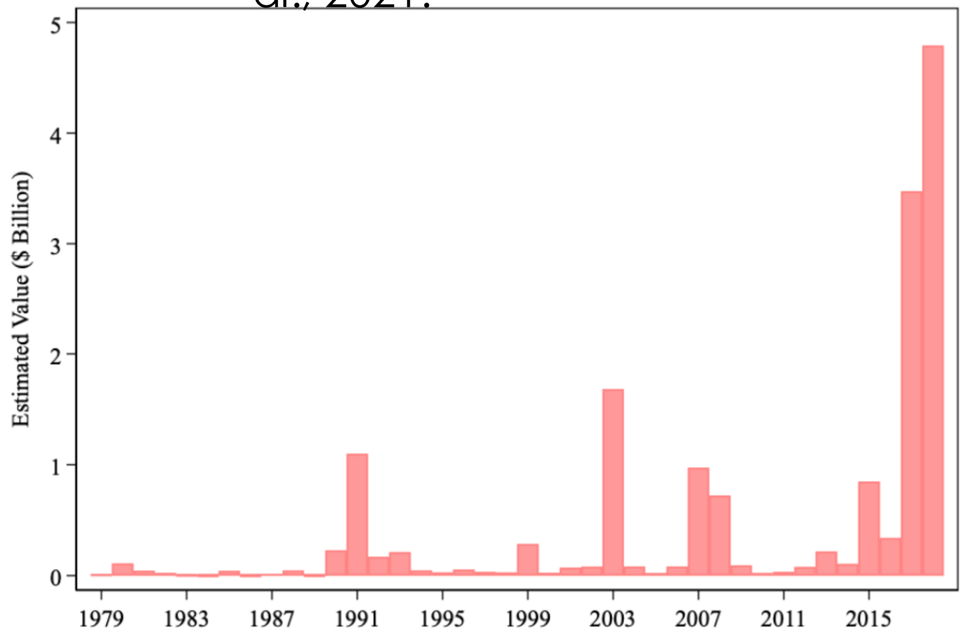
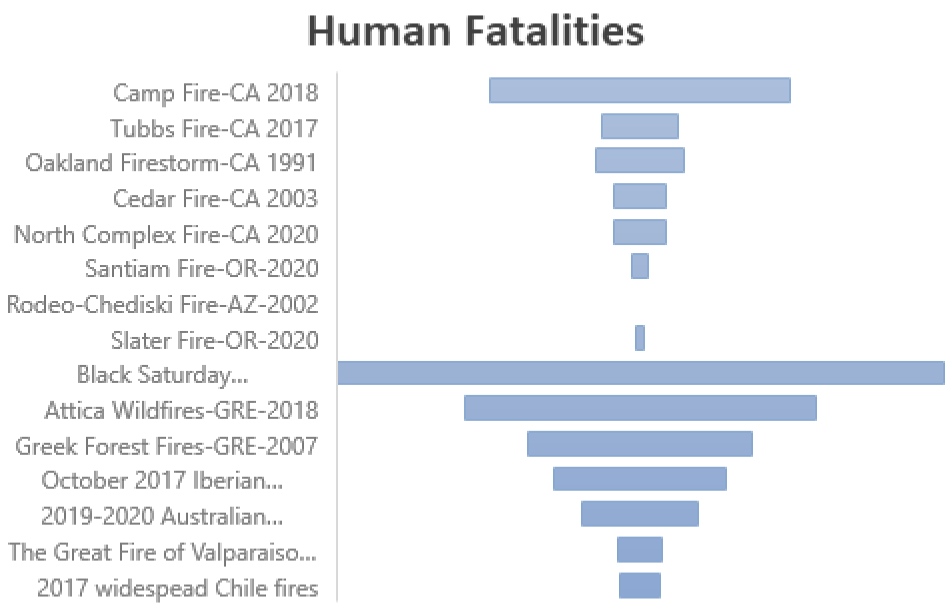


Figure 5. Estimated Value of Structure Losses (in 2018 dollars) for SRA Fires, by Year, 1979 – 2018.

https://emlab.ucsb.edu/sites/default/files/documents/wildfire-brief.pdf



Number of human fatalities due to wildfires in California, Oregon, Arizona USA; Australia; Greece, Spain and Portugal; and Chile from 2003-20.

Urban forests in fire-prone landscapes in California

Fire is an Ecosystem Disservices (ecological processes or costs that *negatively* affect human well-being)

Urban forests provide Ecosystem Services (ecological processes or benefits that *positively* affect human well-being)

Ecosystem Disservices or Service?

Image credit: JOSH EDELSON/AFP/Getty Images.

Josh Edelson / AFP - Getty Images file

- Fire Hazard
- Trees ignite homes on fire
- Smoke emissions
- Hazard Trees
- Homeowner fear
- Insurance coverage

- Ecosystem services
  - Cooling, air quality, runoff, property values
- Green/maintained areas alter fire behavior
- Tree crowns filter embers
- Eventual greening

✓ Many fire are extreme events; other are not
✓ Fire severity is not uniform
✓ Urban forest: cover, structure, maintenance, greenness, proximity to homes, will vary
✓ Many people feel urban forests increase risk; others do not

2nd World Forum on Urban Forests
Washington DC, 2023

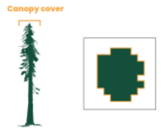
Wildfire effects on Urban and Community Forests

A1) Define and identify "urban" and "community"

- US Census Bureau urban areas
- National Land Cover Database
- Available city/county data

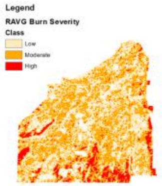
A2) Use available imagery map urban tree cover (UTC)

- National Land Cover Database, 30m
- National Agriculture Imagery Program, 1m
- Salo Sciences California Forest Observatory, 10m



A3) Identify and map fire affected UTC

- Cal Fire's Fire and Resource Assessment Program data
- RAVG burn severity data
- UTC-ecosystem service proxies



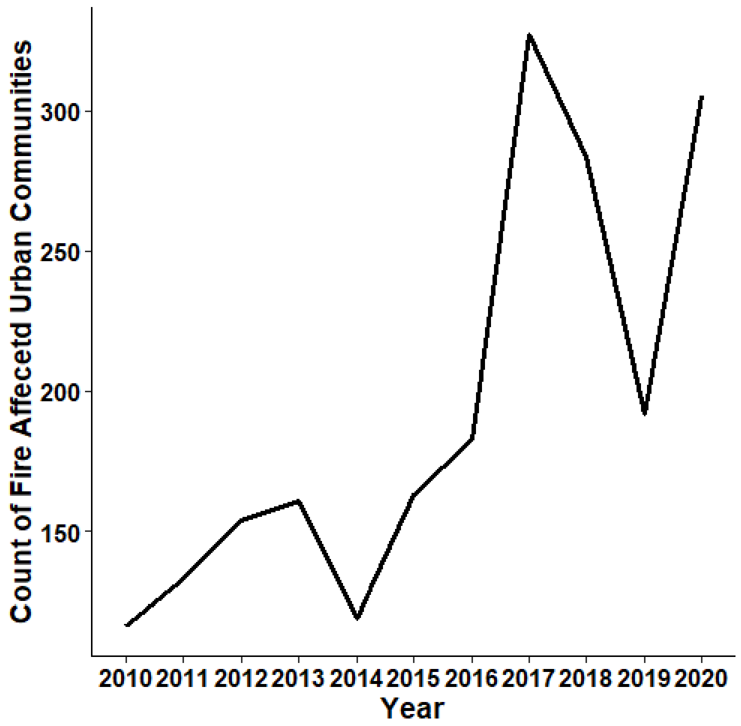
B4) Map urban vegetation types

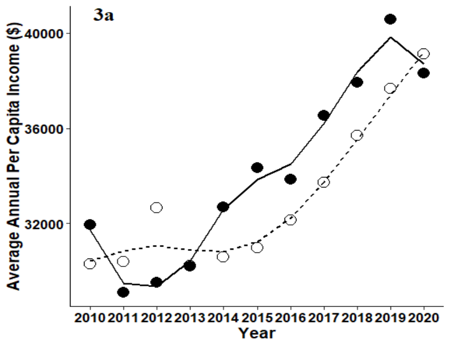
- World-View Imagery (3m)
- Multi-resolution segmentation, Microsoft building foot print, Rule-based Classification

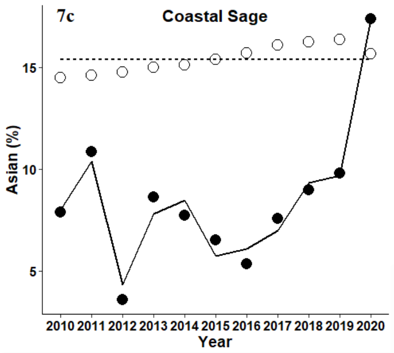
C) Urban forest-Fire-Building interactions

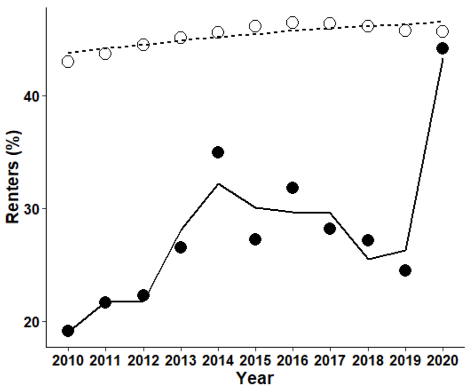
- Object-based classification using Random forest algorithm in eCognition
- Cal Fire DINS, Microsoft buildings, and CoreLogic data
- Building loss/damage-Vegetation type, diversity, greenness, distance interactions

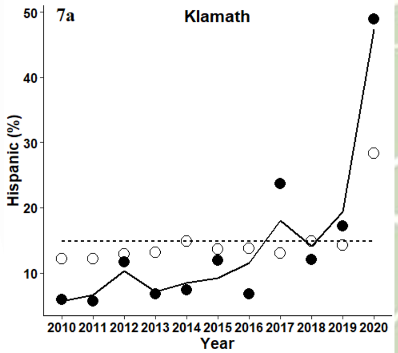
Wildfire affected Urban Communities 2010-2020



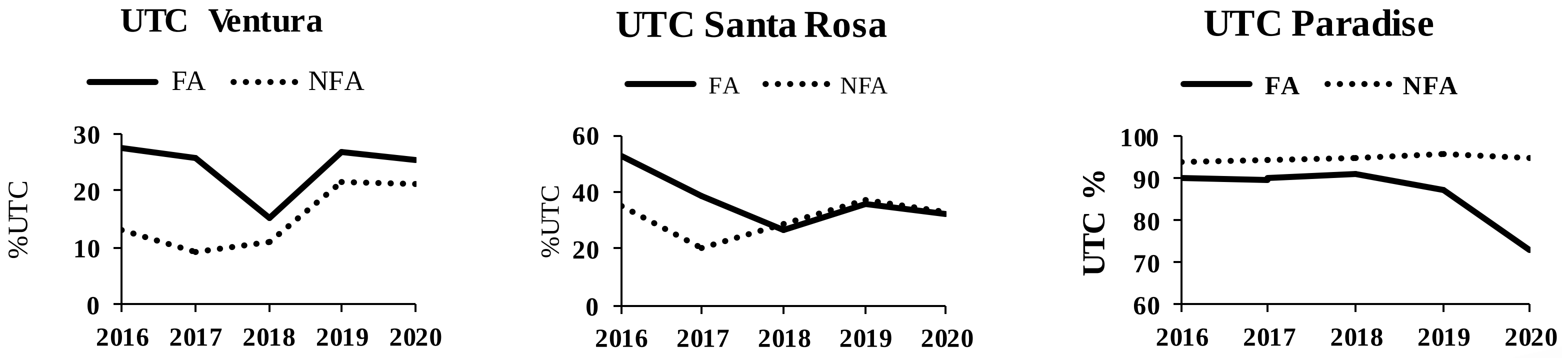








Urban Tree Cover (UTC) change over time

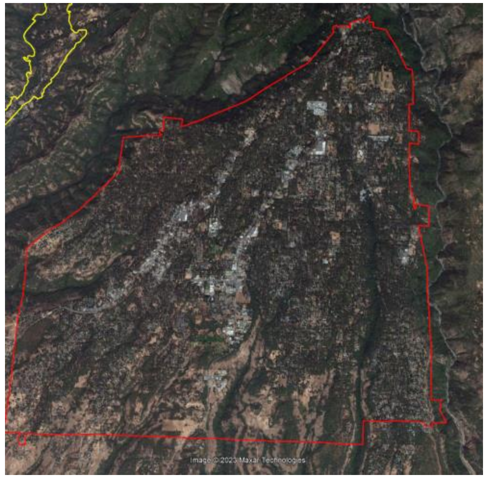


FA= Fire Affected
NFA= Non-fire Affected

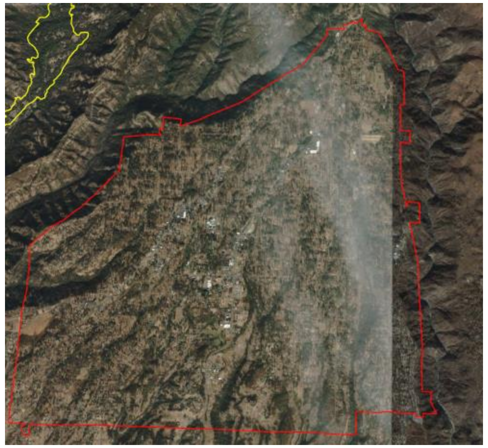
Indicator of resilience and other socio-ecological dynamics

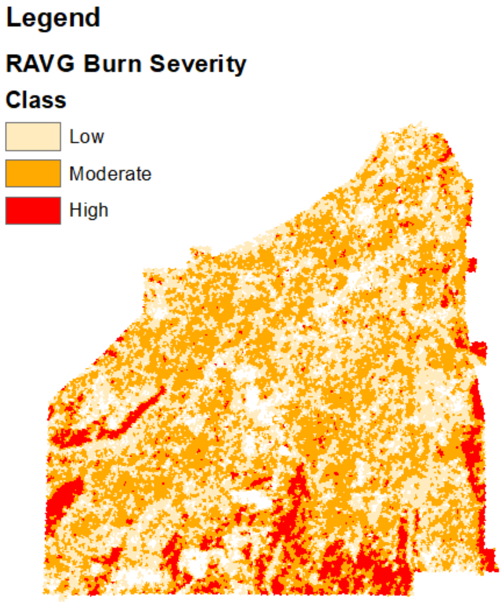
Fire Severity and Ecosystem Services

Pre-fire Google Earth 11/18



Post-fire Google Earth 11/19



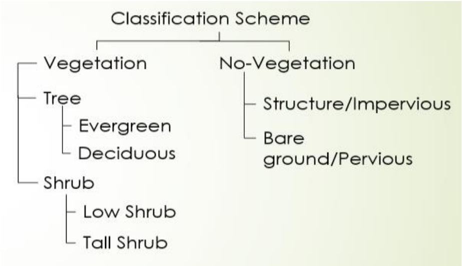


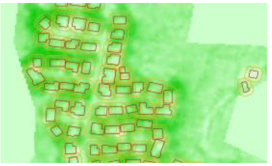
Rapid Assessment of Vegetation Condition After Wildfire (RAVG): High, Moderate, Low Burn severity

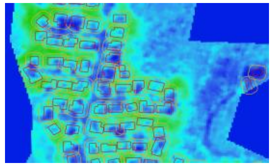
Ecosystem services lost in UTC with High and Moderate fire severity *

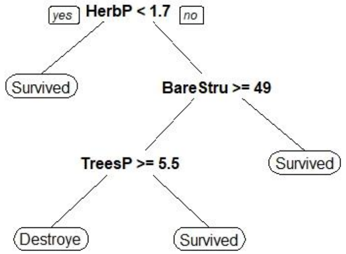
Wildfire (city)	C Storage (t)	C sequestration (t)	Air Quality** (t)	Energy (MWh)	Stormwater (m3)
Thomas (Ventura)	57,307	20,079	20	6,591	47,066
Tubbs (Santa Rosa)	80,638	6,949	7	1,838	144,834
Camp (Paradise)	55,065	14,322	14	764	116,352

*McPherson, E. Gregory, et al. "The structure, function and value of urban forests in California communities." Urban Forestry & Urban Greening 28 (2017): 43-53.
**$PM_{10}+O_3+SO_2+NO_2$





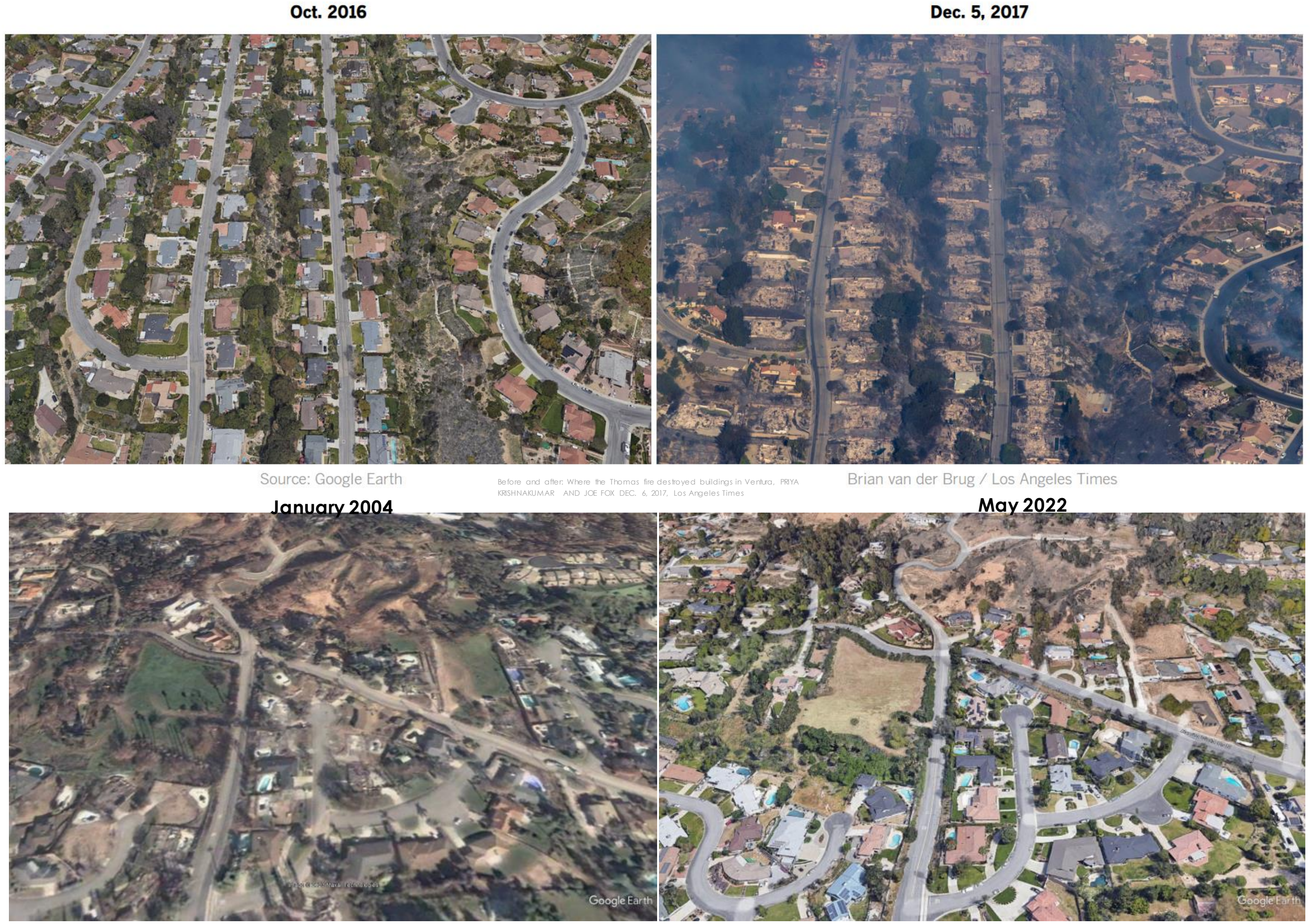




On-going Research

- Urban forest structure greenness and building loss
- Post-fire urban tree mortality study is on-going (A. Ossola, UCD; R Klein, UF)
- Urban tree/shrub flammability study (N Van Doorn, S Drury USFS)
- Post-fire urban forest restoration manual and guidelines for western urban forests (USFS & UC Extension)

Communities will rebuild



Ventura, CA

San Bernardino, CA

- Cities increasingly being affected by fire!
- No longer Wildland-Urban Interface/Peri-urban problem
- What urban forests do we want post-fire; short and long-term?
- Disservices can be minimized; but there will be trade-offs

Thank you

Francisco J Escobedo | US Forest Service &

Los Angeles Urban Center

Francisco.Escobedo@usda.gov

CEUs

Session 3.5: The Day of the Triffids: How to manage risks associated with urban forests (invasive species, allergies, fires, breakages, falls)

CEU ISA

PP-23-3573

World Forum on Urban Forests