



# Optimising tree selection for future ecosystem services

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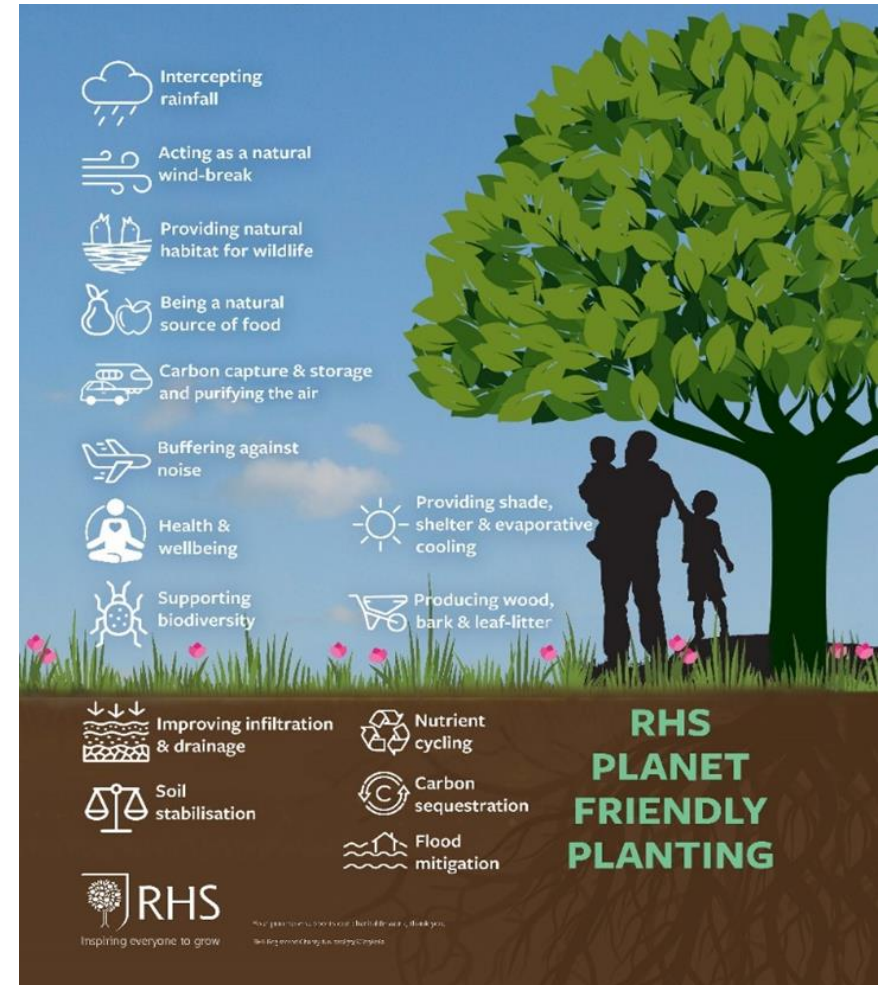


Frank P Matthews



# What ecosystem services do we want?

- Cooling
- Flood mitigation
- Carbon sequestration /storing
- Support for wildlife (food, habitat)
- Pollution mitigation
- Noise reduction
- Wellbeing
- Aesthetically pleasing

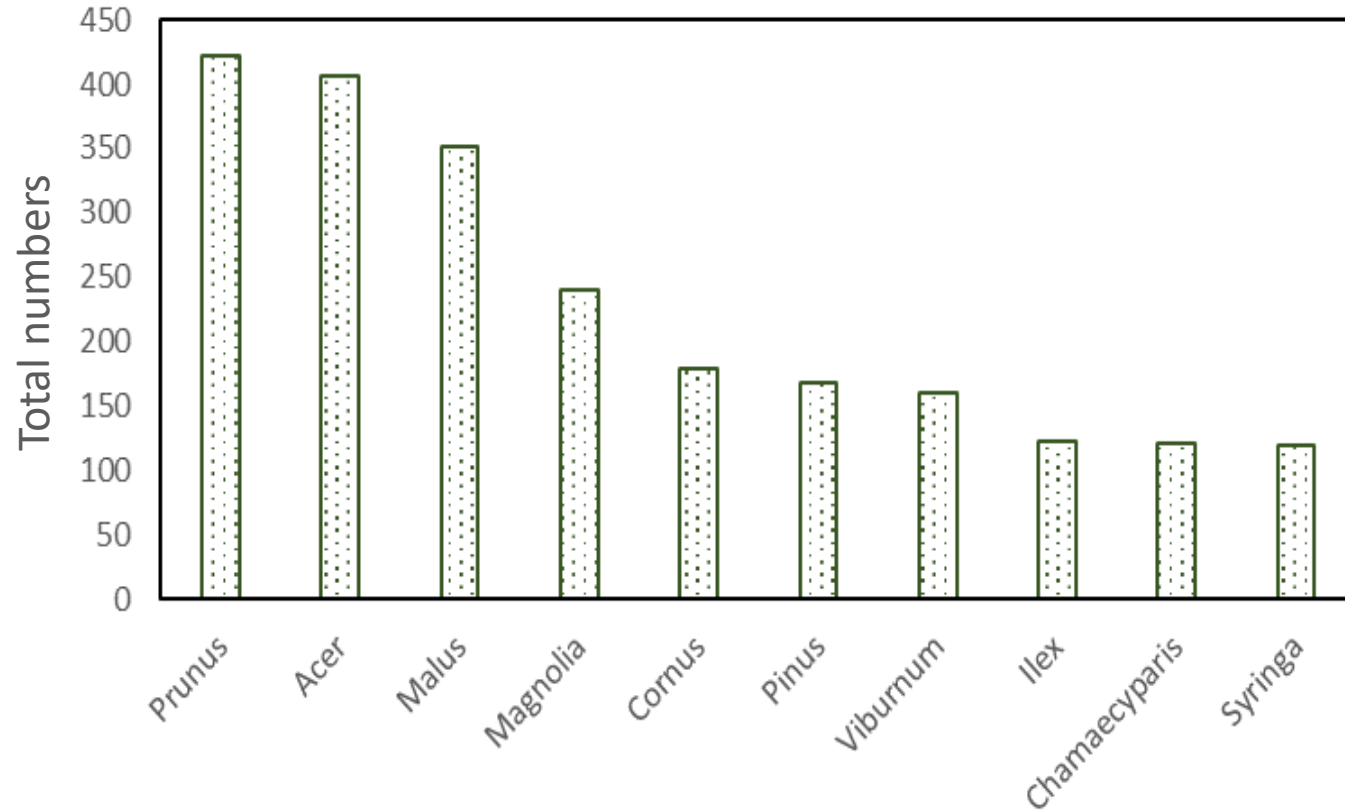


# Trees in gardens

- Domestic gardens make up 30% of urban space in the UK
- Trees within gardens play a key role
- Services vary between species
- Motivation and management differ in private garden to public landscapes
- Regulating services often relate to tree size 'The bigger the better'
- Species-specific information needed for gardeners, trees appropriate for smaller gardens



# What trees do people plant in their gardens?



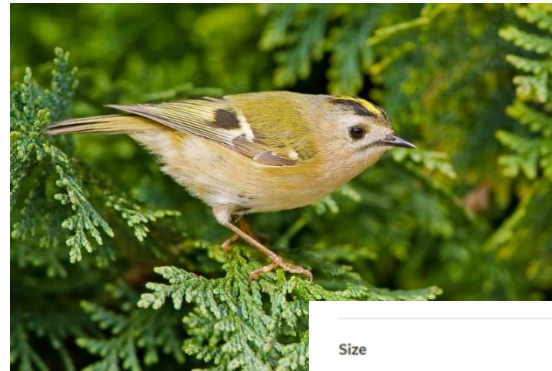
Trees with a great colour display/ smaller in size/ magnitude of cultivars

# Conflict of service delivery

Leyland cypress (x *Cuprocyparis leylandii*)



Dense crown  
Shade, high LAI



Fast growing, offset of CO<sub>2</sub>  
Favoured hunting spot for birds such as goldcrest

**x *Cuprocyparis leylandii***  
(Leyland cypress)

**Use potential**  
Park Coastal Transport corridor

**Tree size and crown characteristics**  
A large tree capable of reaching 25m, but many cultivars are smaller. A large columnar crown. A dense crown.

**Natural habitat**  
A hybrid between *Cupressus macrocarpa* and *Xanthocyparis nootkatensis* (syn *Cupressus nootkatensis* syn *Callitrostris nootkatensis*). Adaptable to a wide range of soils and tolerant of salt laden winds.

**Environmental tolerance**  
Estimated to be intolerant to shade. Estimated to be tolerant to drought. Estimated to be sensitive to waterlogging.

**Ornamental qualities**  
Inconspicuous. Most varieties appear sterile. Evergreen conifer with fine scale-like leaves.

**Size**

↑ **Ultimate height**  
Higher than 12 metres

🕒 **Time to ultimate height**  
10–20 years

↔ **Ultimate spread**  
4–8 metres

**Colour & scent**

	Stem	Flower	Foliage	Fruit
Spring			🌿	
Summer			🌿	
Autumn			🌿	
Winter			🌿	

**Growing conditions**

Loam Chalk Sand Clay

**Moisture**  
Well-drained

**pH**  
Acid, Alkaline, Neutral

**Position**

☀️ Full sun ☁️ Partial shade

**Aspect**  
West-facing or South-facing or North-facing or East-facing

**Exposure**  
Exposed or Sheltered

**Hardiness**  
H6

Tolerant to drought, intolerant to shade  
Can get too big and too dense in a garden context  
Also divided opinion on the aesthetics

# RHS ongoing research

- Ecosystem services trial – measurements of 20 cultivars, main focus on regulating services: cooling, rainfall mitigation and carbon
- Surveys – Sustainability survey – Dr Chloe Sutcliffe
- MSc – how does leaf colour impact cooling potential?
- RHS my garden; what trees do people have in their garden
- Hedges and ecosystem services – Dr Tijana Blanus



# Trees cut down in domestic gardens

- Survey by Dr Chloe Sutcliffe (RHS)

21.5% had cut down trees during the last three years

23.3% had planted new trees in the last three years

Most common reason why trees were cut down:

1. Too large for the space available (38.1%)
2. Trees too close to a building (20.3%)
3. Trees were creating too much shade (16.3%)
4. Trees had died due to extreme weather (13.9%)
5. Make way for new construction (13.3%)
6. Tree causing subsidence (7.8%)
7. Trees were causing allergies (2.4%)



# Traits connected to ecosystem services' delivery

Wide, tall and multi-stratified with large-leaved evergreen species	higher rainfall and pollution capture efficiency/ noise mitigation	Blanusa et al., 2019; Becket et al., 2000; Freer-Smith et al. 2004; Rasanen et al. 2013;
Rough leaf surfaces/hairy leaves/ lanceolate-shaped/ larger leaves	Absorbance of PM/ heavy metals	Blanusa et al. 2019 Leonard et al. 2016
High leaf density, wide canopy	Cooling through shading	Vaz Monteiro, et al. 2019
Lighter leaf colour	Increased reflection of solar radiation	Vaz Monteiro, et al. 2019;



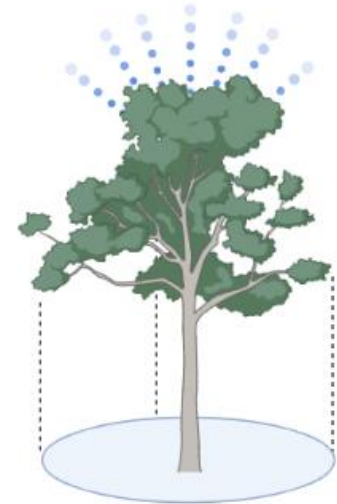
# Cooling capacity of trees

- Urban vegetation can reduce air temperature between 0.5- 8°C
- Tree-shade can reduce surface temperature by 12-20 °C

## **Urban heterogeneity, micro-meteorological factors and Species selection alter cooling effectiveness**

The higher the transpiration → the more cooling effect through transpiration

The denser the crown → more cooling through shading



(Rahman et al. 2019;2015; Vaz Monteiro et al.,2029; Smithers et al. 2018; Vico et al. 2014)

# Ecosystem services and garden trees



## **Continuous measurements**

- Sap flow (three replicates)
- Growing media moisture
- Meteorological parameters

## **Point measurements**

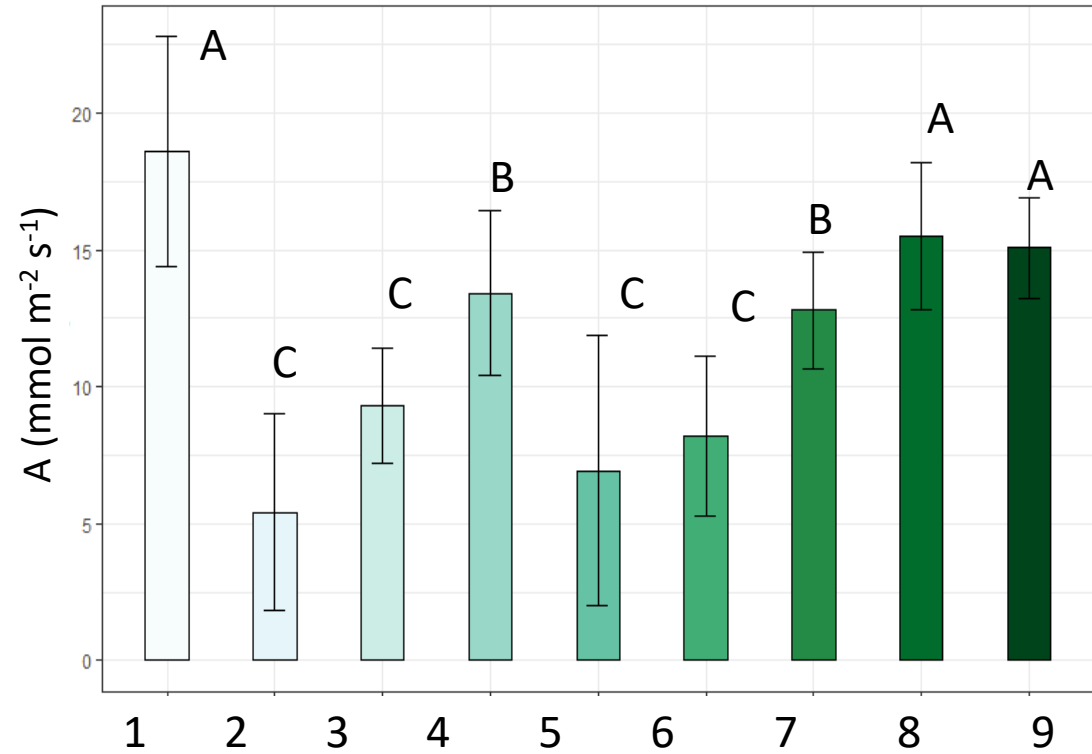
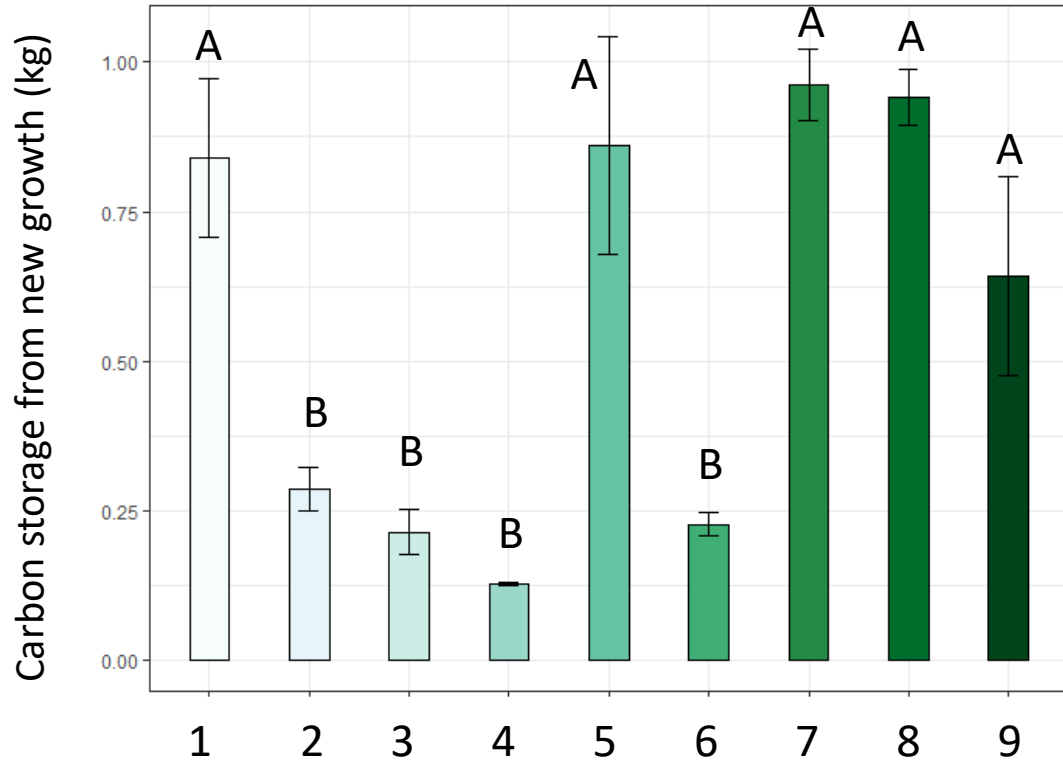
- Biomass (wood)
- Leaf area
- Crown dimensions
- Gas exchange

# Experimental design

- Nine species - six replicates
- Planted in February 2021
- Four/five-year old trees
- Randomised block design
- 2-4 meters tall
- 130 L size containers



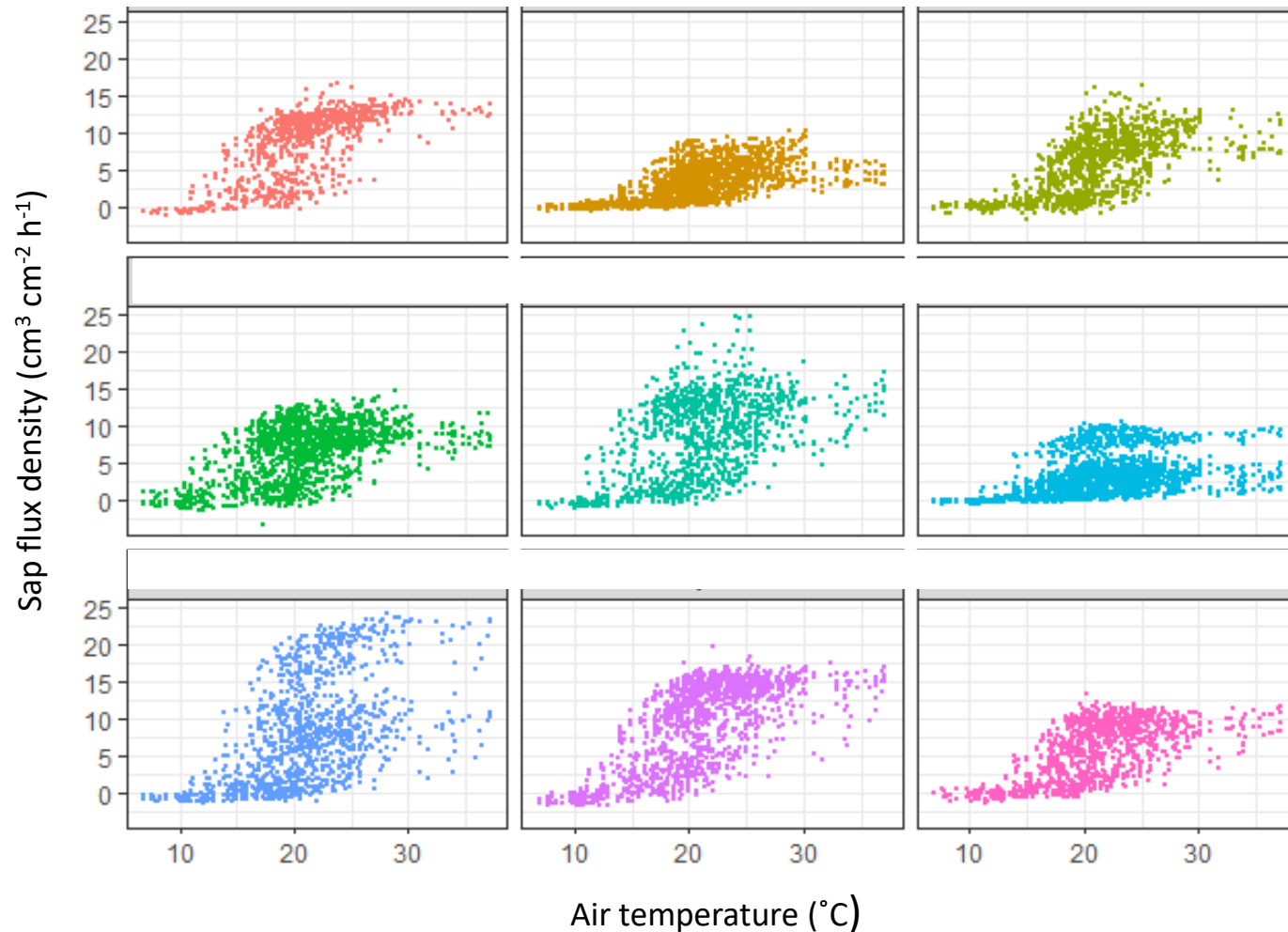
# Carbon storage and CO<sub>2</sub> sequestration



Carbon storage between 0.1 - 0.8 kg for one growing season

Carbon sequestration 5 – 18 mmol m<sup>-2</sup> s<sup>-1</sup>

# Air temperature and transpiration July 2022



Trees irrigated were still transpiring with air temperature of 37.1°C

However, differed in when transpiration increased and plateaued in relation to air temperature

No observed decrease in transpiration at highest temperature

# Summary

- Gardens, both private and public has the potential to contribute to increased canopy cover, biodiversity and ecosystem services
- Trees are being cut down due to inappropriate species selection
- Research is needed to fuel the advice gardeners are given
- Specifically, what trees are going to be appropriate for smaller spaces while also growing in a warmer climate
- A range in carbon storage, transpiration and crown size was found in nine tree cultivars measured



# Thank you for listening

Thanks to

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Rebekah Mealey

Jim Arbury



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