Ten Principles to help maximise ecosystem services from trees in urban environments

Trees & Design Action Group

University Centre Myerscough

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Provisioning
Food;
Fibre and timber;
Energy;

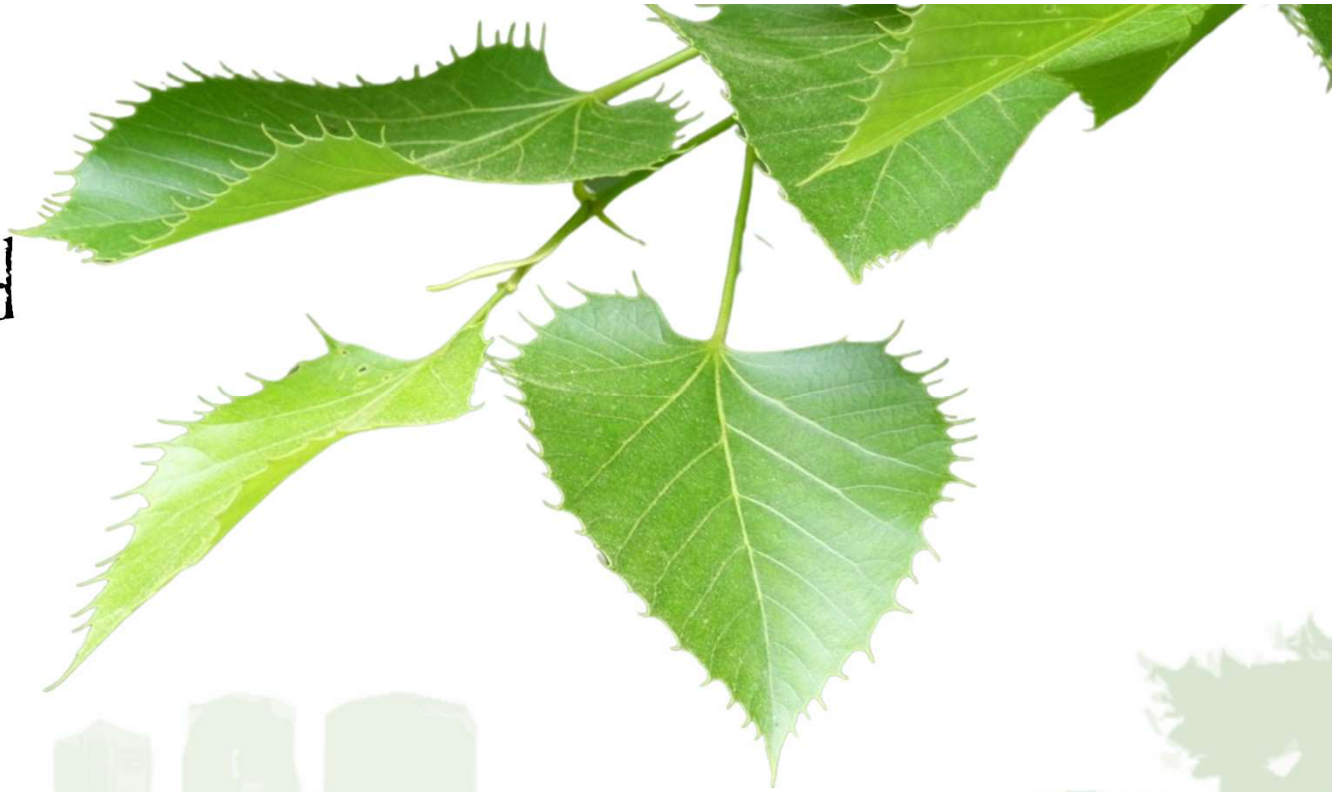
Cultural
Recreational values;
Cultural heritage;
Aesthesis values;
Pedagogical values;
Eco-tourism;
Eco-therapy

Regulating
Shade;
Temp modification;
Wind regulation;
Carbon storage;
Carbon sequestration;
Air pollution removal;
Flood mitigation

Urban trees and ecosystem services

Supporting
Habitat provision;
Pollination;
Nutrient cycling;
Photosynthesis;
Oxygen synthesis;
Biomass production

Principle 1: Promote health and vitality in existing tree stock

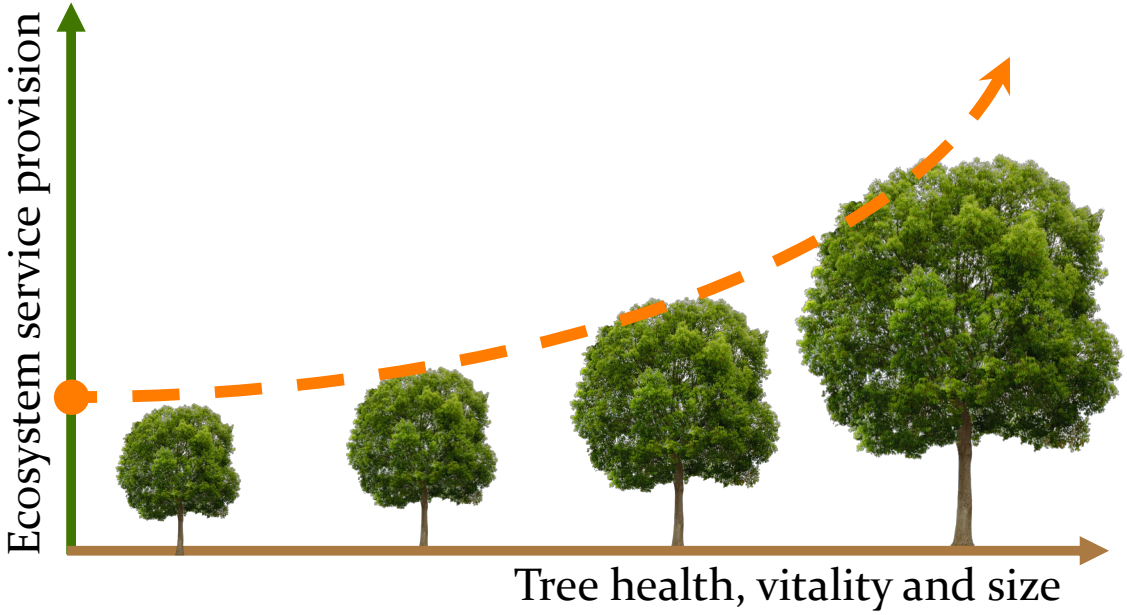


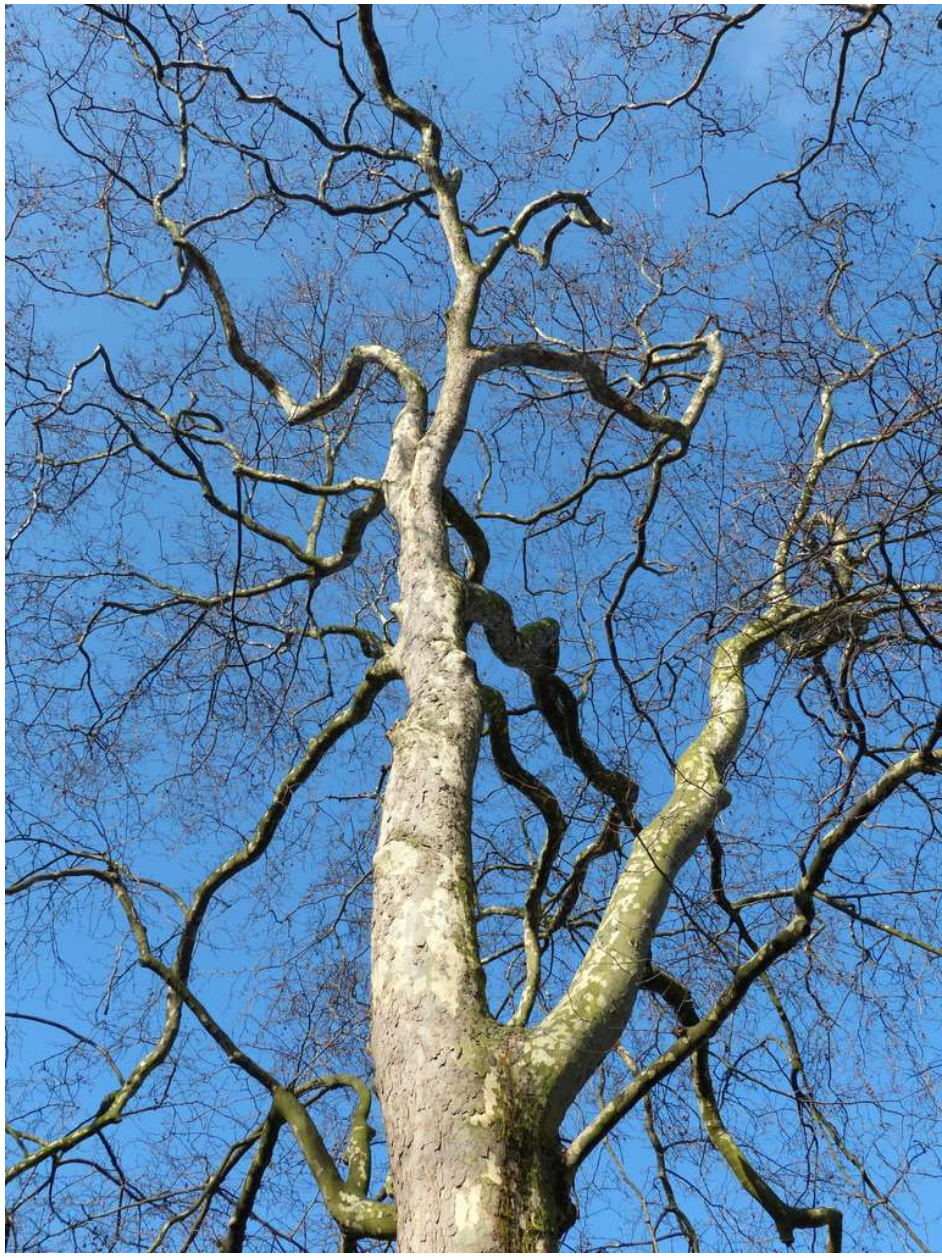
- Established trees are critical for the delivery of ecosystem services

Principle 2: Make provision for large trees

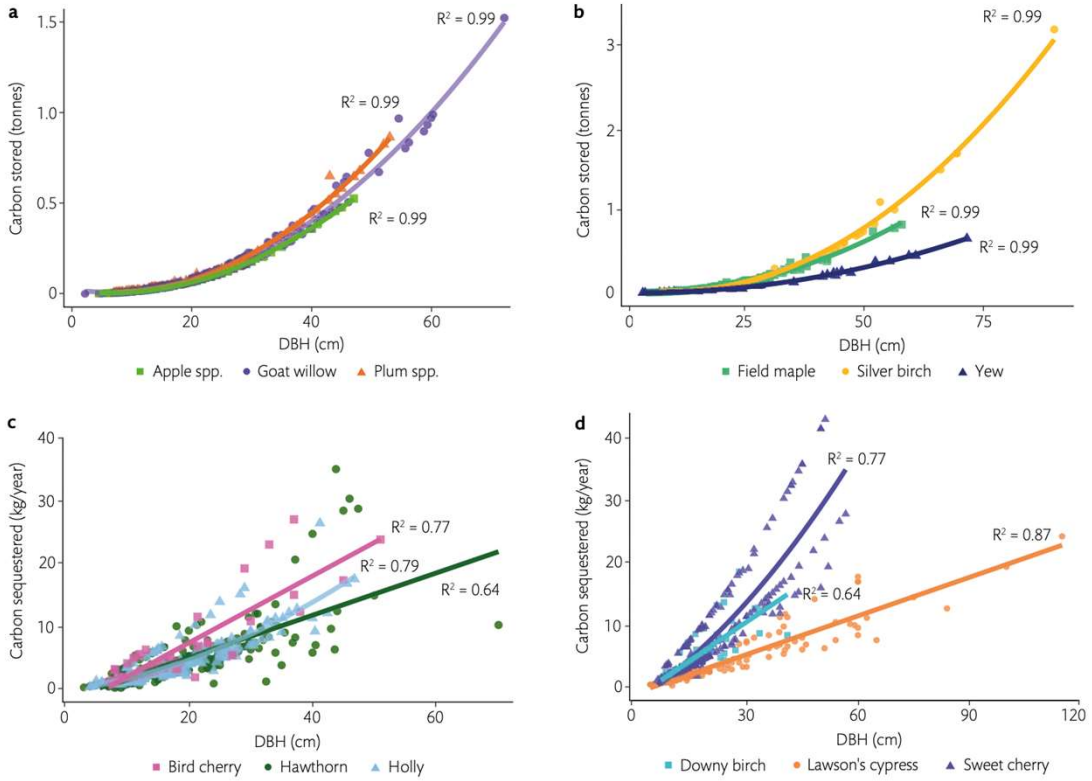
- Intentionally design space for large, long-lived trees in the urban realm

Tree Size Matters



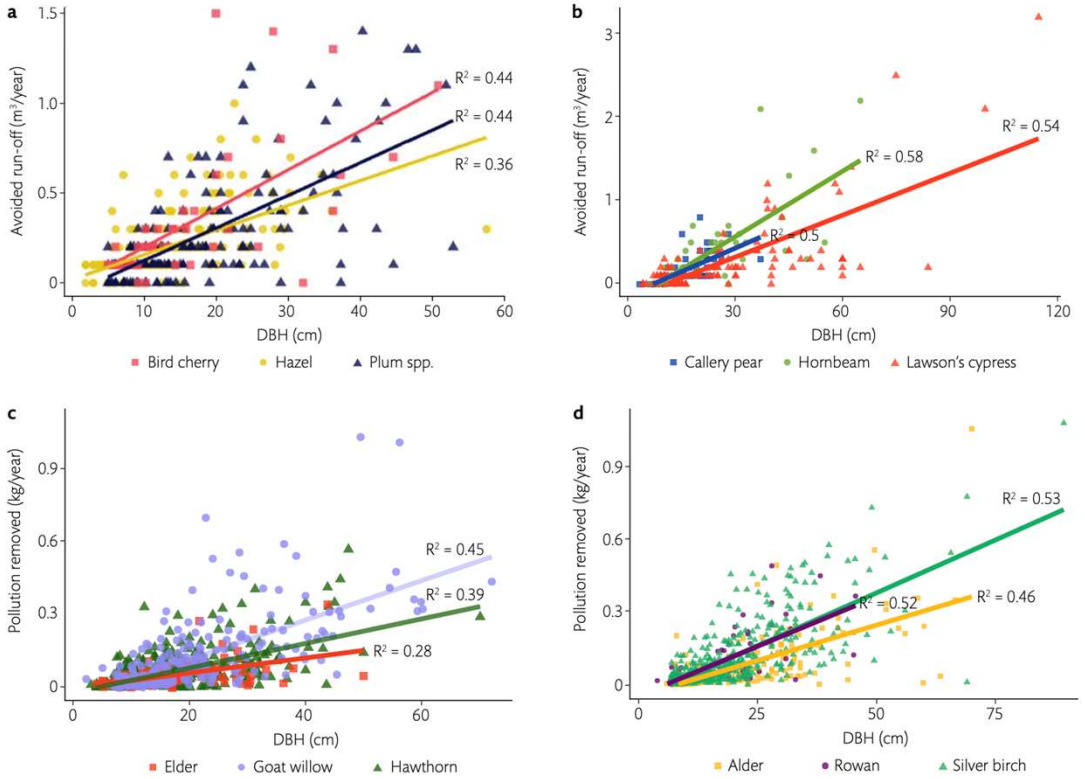


Evidence - Carbon storage and carbon sequestration



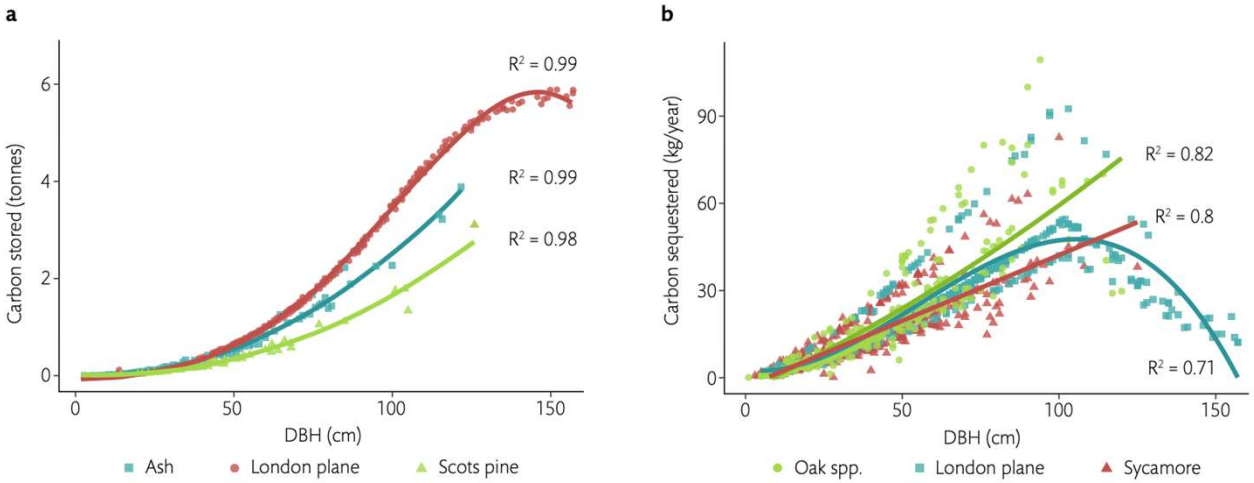
Estimated delivery of carbon storage (top row) and carbon sequestration (bottom row) for a subset of (a, b) small and (c, d) medium stature species. All trees are modelled based on the southwest England climate.

Evidence – Run off and air pollution removal



Estimated delivery of (a, b) avoided run-off and (c, d) air pollution removal for a subset of (a, c) small and (b, d) medium stature species. All trees are modelled based on the southwest England climate.

Evidence for large trees



(a) Carbon storage and (b) gross carbon sequestration of individual trees, modelled for southwest England.

Principle 3: Establish ecosystem service priorities

- Different trees have different qualities, decide on your priorities.

Trees for cooling

- Crown density (Leaf Area Index)
- Crown size
- Transpiration rate

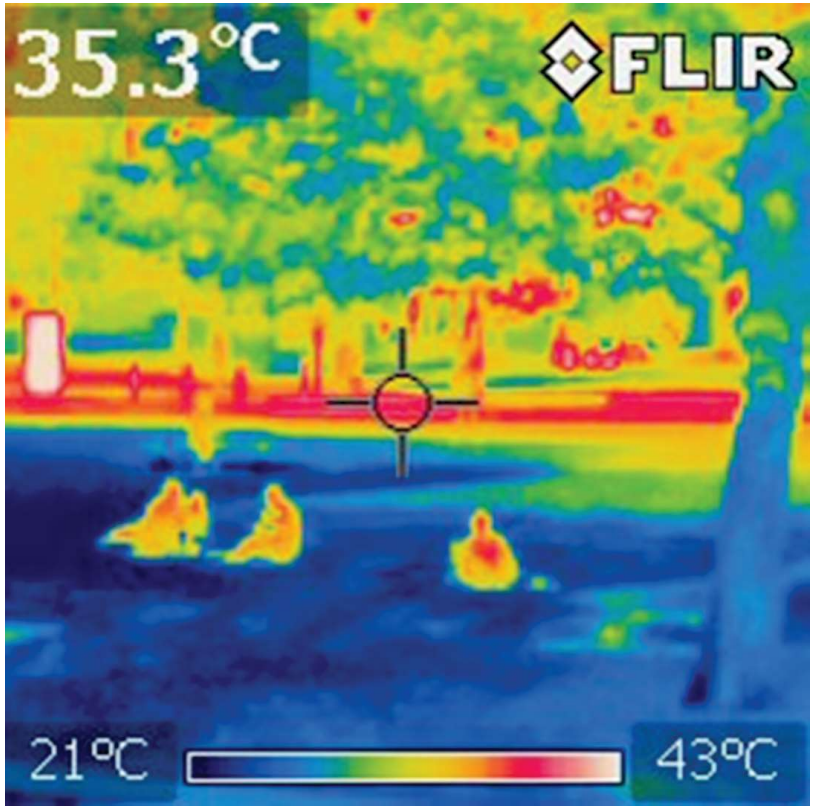


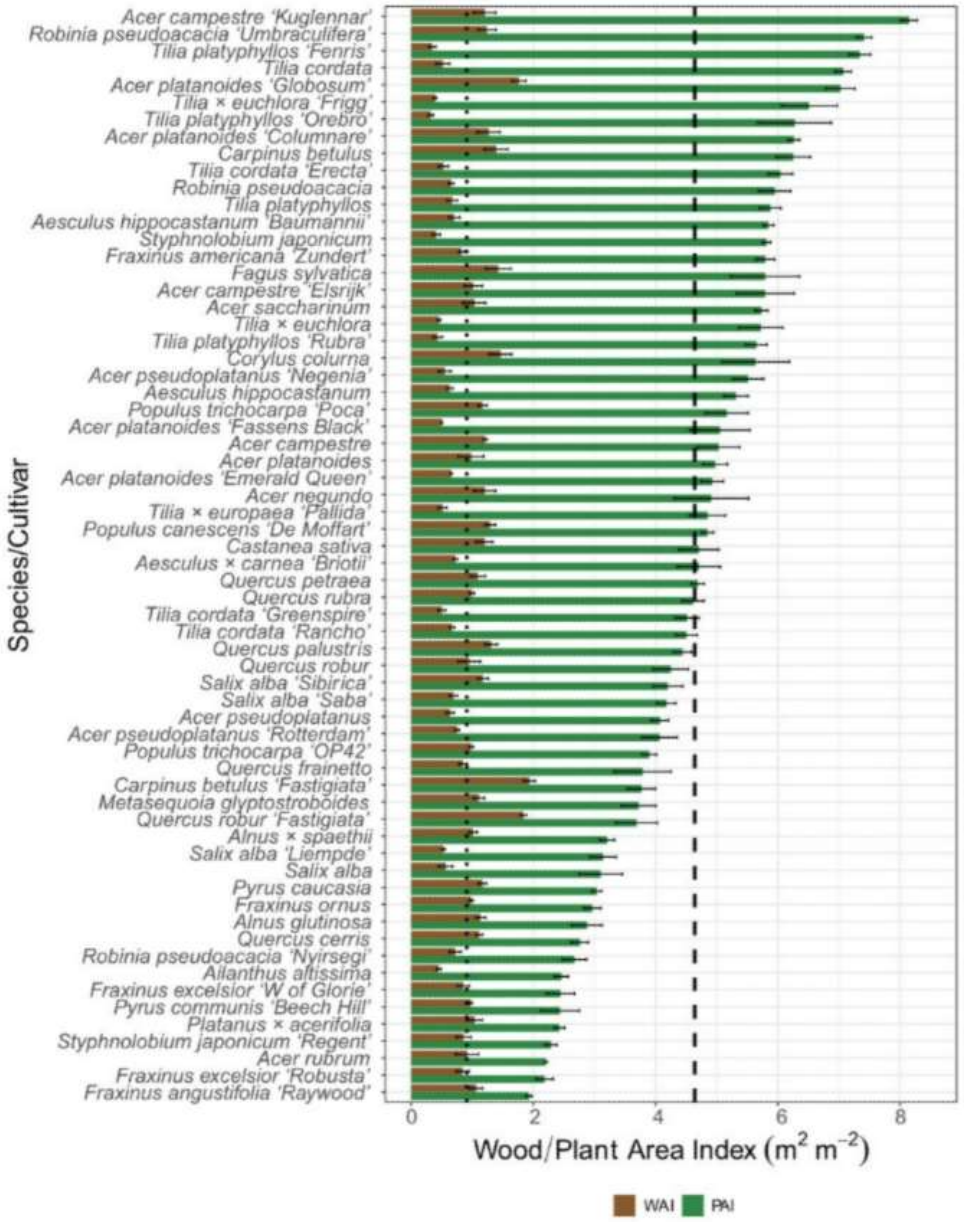
Image © Roland Ennos, used with kind permission.

Large differences in Plant Area Index across species

Arboriculture & Urban Forestry 2021. 47(6):252–266
https://doi.org/10.48044/jauf.2021.022

Plant and Wood Area Index of Solitary Trees for Urban Contexts in Nordic Cities

By Johanna Deak Sjöman, Andrew Hirons, Nina Bassuk, and Henrik Sjöman

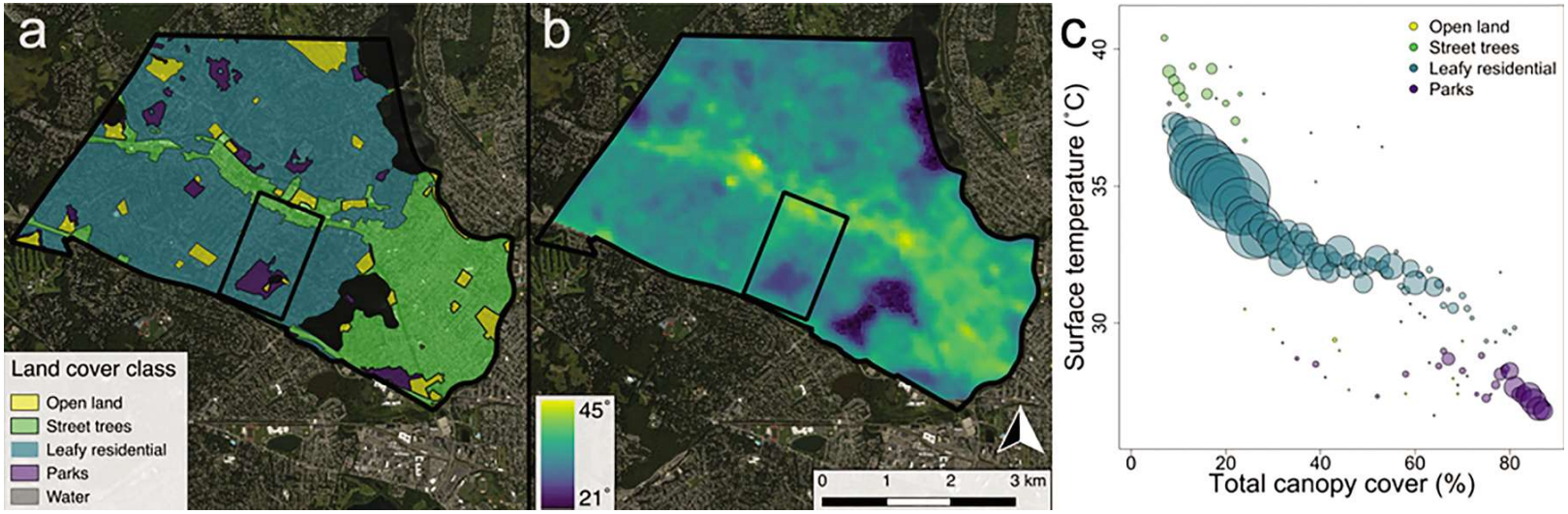


Overview Articles

Tree Transpiration and Urban Temperatures: Current Understanding, Implications, and Future Research Directions

JOY B. WINBOURNE, TAYLOR S. JONES, SARAH M. GARVEY, JAMIE L. HARRISON, LIANG WANG, DAN LI, PAMELA H. TEMPLER, AND L. R. HUTYRA

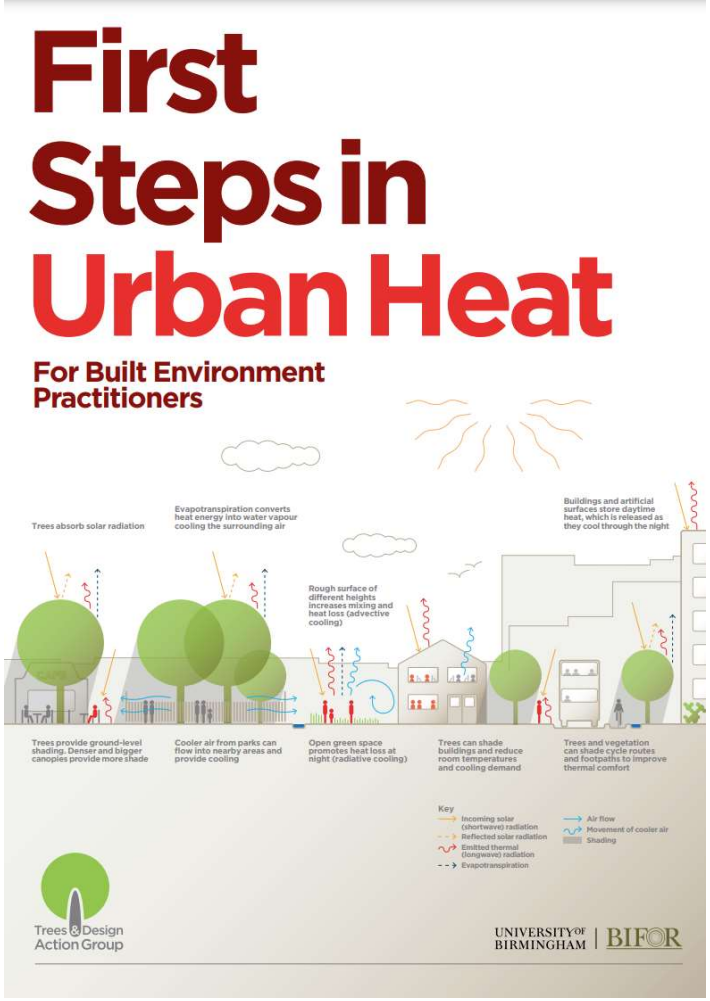
Canopy for Cooling

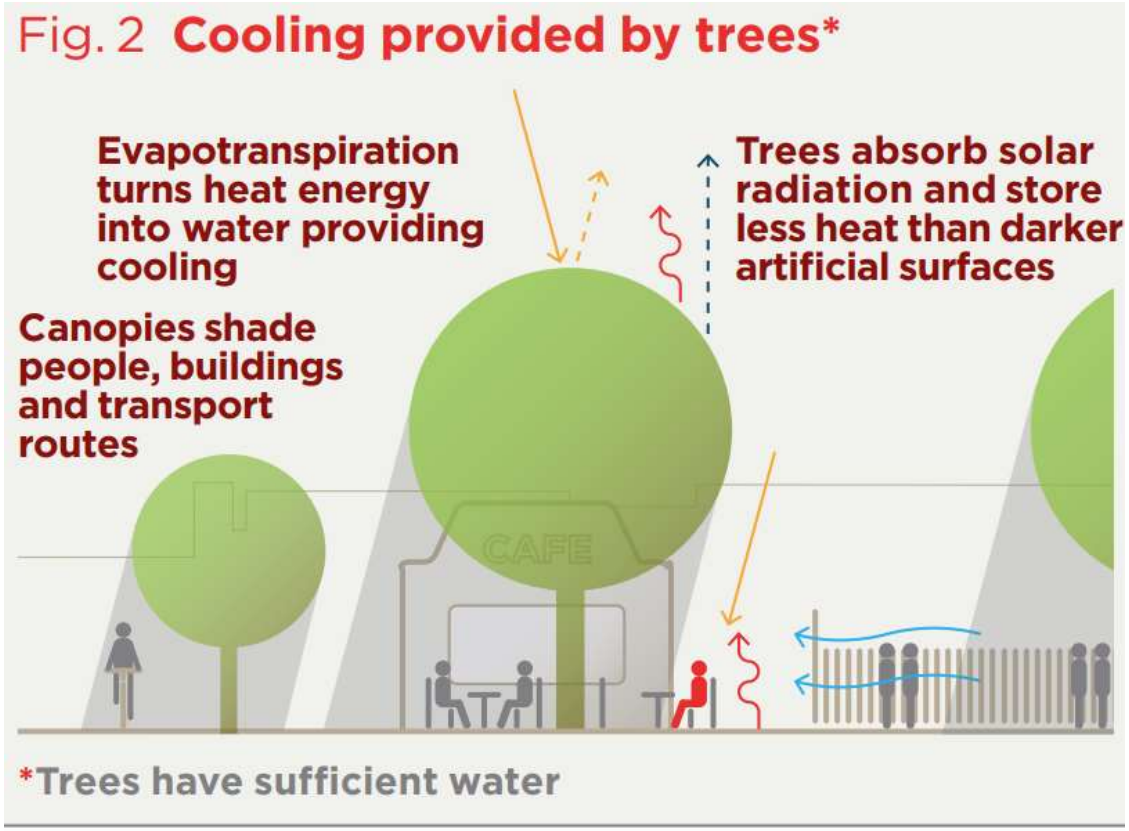


The relationships between land cover classes (a) and land surface temperature (b). In panel (c) the relationship between land surface temperature and total canopy cover is shown for the Menotomy Rocks Park in Arlington, Massachusetts

BioScience, Volume 70, Issue 7, July 2020, Pages 576–588, https://doi.org/10.1093/biosci/biaa055

Trees and Design Action Group - Guidance

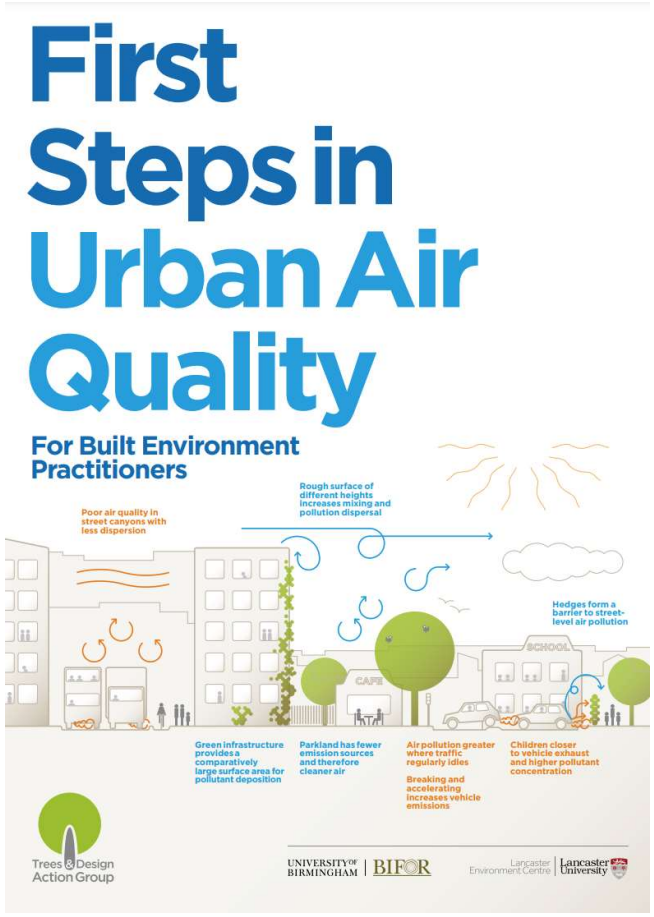




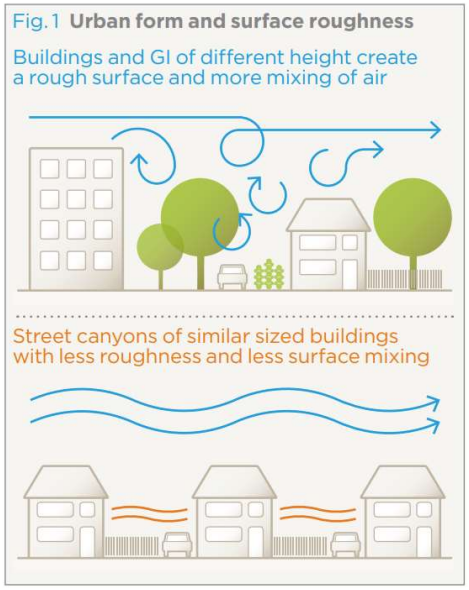
Flood Mitigation

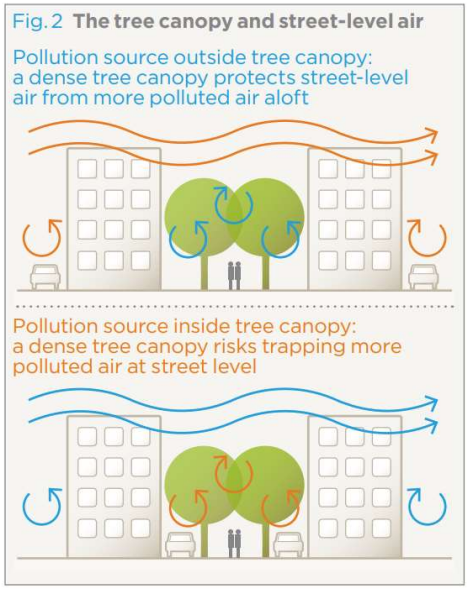
- Large, healthy trees with dense crowns and highly textured surfaces (leaves and bark) intercept and store water most effectively
- Leaf phenology (Evergreen vs. Deciduous)
- Tree pits, even for small trees, can considerably increase infiltration into soils by reducing surface run-off
- Rooting depth and morphology will also modify soil infiltration

Air quality regulation



- Tree size
- Leaf surface morphology (roughness and hairiness)
- Ventilation and turbulence
- Behavioural change





Biodiversity and Habitat

- Native usually best for biodiversity

However…

- Some non-invasive, non-native species have real value as they flower at different times and offer viable habitat

- Coming soon… (we hope)

Principle 4: Minimise disservices

- Use species selection to reduce allergenicity, residual risks and other disservices.

Principle 5: Select trees to thrive, not just survive

- Evidence based tree selection
- Select trees with foresight, not hindsight

Principle 6:
Diversify strategically

- Taxonomic diversity (within abiotic and biotic constraints)
- Functional diversity

Principle 7:
Actively manage risks

- Climate risks
- Biosecurity risks
- Planning and policy risks

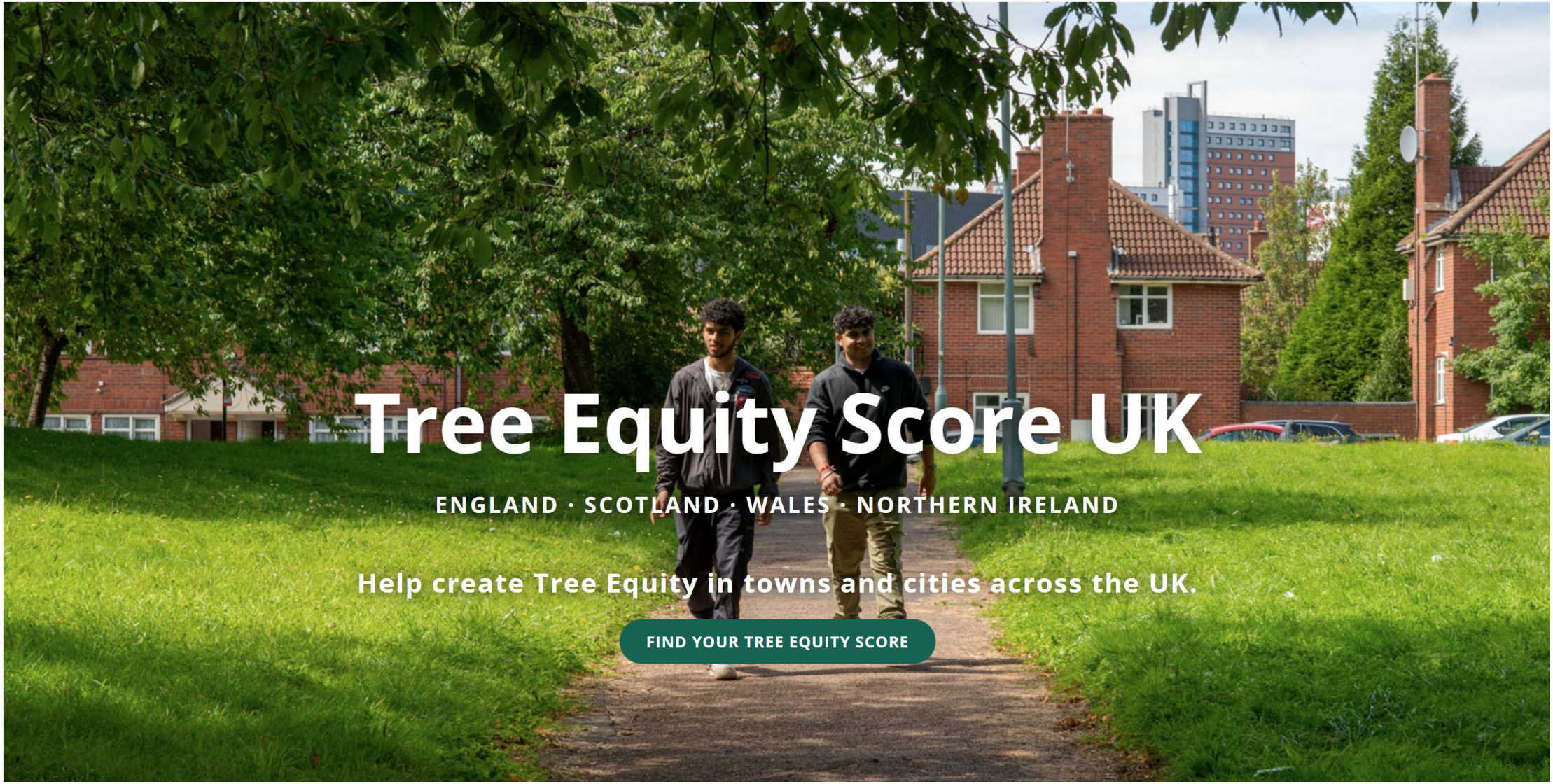
Principle 8: Foster tree supply chains

- Protect and collaborate with tree nurseries
- Plant quality, species choices and biosecurity rely on good nurseries

Principle 9: Focus on equity of greenspace provision

- Ensure that all sectors of society have access to trees and greenspace
- 3-30-300 Policy

TREE EQUITY SCORE UK



Tree Equity Score UK

ENGLAND · SCOTLAND · WALES · NORTHERN IRELAND

Help create Tree Equity in towns and cities across the UK.

FIND YOUR TREE EQUITY SCORE

NATIONAL GEOGRAPHIC

Along one Los Angeles street, wealthy areas are shady and cool.

The tree canopy decreases and temperatures rise as you drive south.

On a warming planet, this divide between rich and poor leaves many at risk.

BEATING THE HEAT

3-30-300 Rule

J. For. Res.
https://doi.org/10.1007/s11676-022-01523-z

ORIGINAL PAPER

Evidence-based guidelines for greener, healthier, more resilient neighbourhoods: Introducing the 3–30–300 rule

Cecil C. Konijnendijk[1]

Received: 18 January 2022 / Accepted: 7 August 2022

Abstract The important contributions of urban trees and green spaces to for example, climate moderation and public health have been recognized. This paper discusses guidelines and norms that promote the benefits of viewing green, living amongst green, and having easy access to green spaces for recreational use. Having trees and other vegetation in sight from one's home, place of work, or school has important mental health and performance benefits. Local tree canopy cover is positively associated with cooling and other aspects of climate moderation. With public green spaces in proximity to one's home stimulates regular use of these areas and results in positive impacts on mental, physical, and social health. After analyzing existing guidelines and rules for urban green space planning and provision, a new, comprehensive guideline is presented, known as the '3–30–300 rule' for urban forestry. This guideline aims to provide equitable access to trees and green spaces and their benefits by setting the thresholds of having at least 3 well-established trees in view from every home, school, and place of work, no less than a 30% tree canopy in every neighbourhood, and no more than 300 m to the nearest public green space from every residence. Current implementation of this new guideline is discussed, as well as the advantages and disadvantages of using this evidence-based but also clear and simple rules.

The online version is available at http://www.springerlink.com.

Corresponding editor: Yu Lei

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[1] Nature Based Solutions Institute, Barcelona, Spain

Published online: 26 August 2022

Keywords Climate adaptation · Guidelines · Public health · Trees · Urban forestry

Introduction

With most of the world's population living in urban areas, there is an increasing focus on making these healthier, more attractive, and more liveable. Although urban areas provide opportunities such as employment, education, recreation, and social interactions, they also face specific challenges. Cities are often hardest hit by climate changes through the urban heat island effect and by extreme weather events such as major heat waves (Devisscher et al. 2019). The European Union (EU) recorded more than a third heat-related mortality in the elderly, with 104,000 out of 296,000 global deaths in 2018, a year when northern Scandinavia experienced temperatures over 5 °C warmer than in 1981–2010 (Taylor 2020).

Air pollution is a major threat to urban areas. In 2018, 34% of urban populations of the 27 EU countries (then including the United Kingdom) were exposed to ground-level ozone particles at concentrations above EU health target levels, while 15% were subjected to hazardous PM_{10} particles at levels above the EU daily limit (EEA 2020). With 84% of the population in Europe exposed to $PM_{2.5}$ levels above the maximum suggested by the World Health Organization, up to 125,000 lives could be saved annually if $PM_{2.5}$ concentrations were reduced to safe levels (IS Global 2021).

Public health challenges faced by urban populations can also be linked to risk factors and lifestyle diseases such as stress, cardiovascular diseases, and obesity (WHO 2016, 2017). The COVID-19 pandemic has created an immediate and often devastating public health challenge to cities, with

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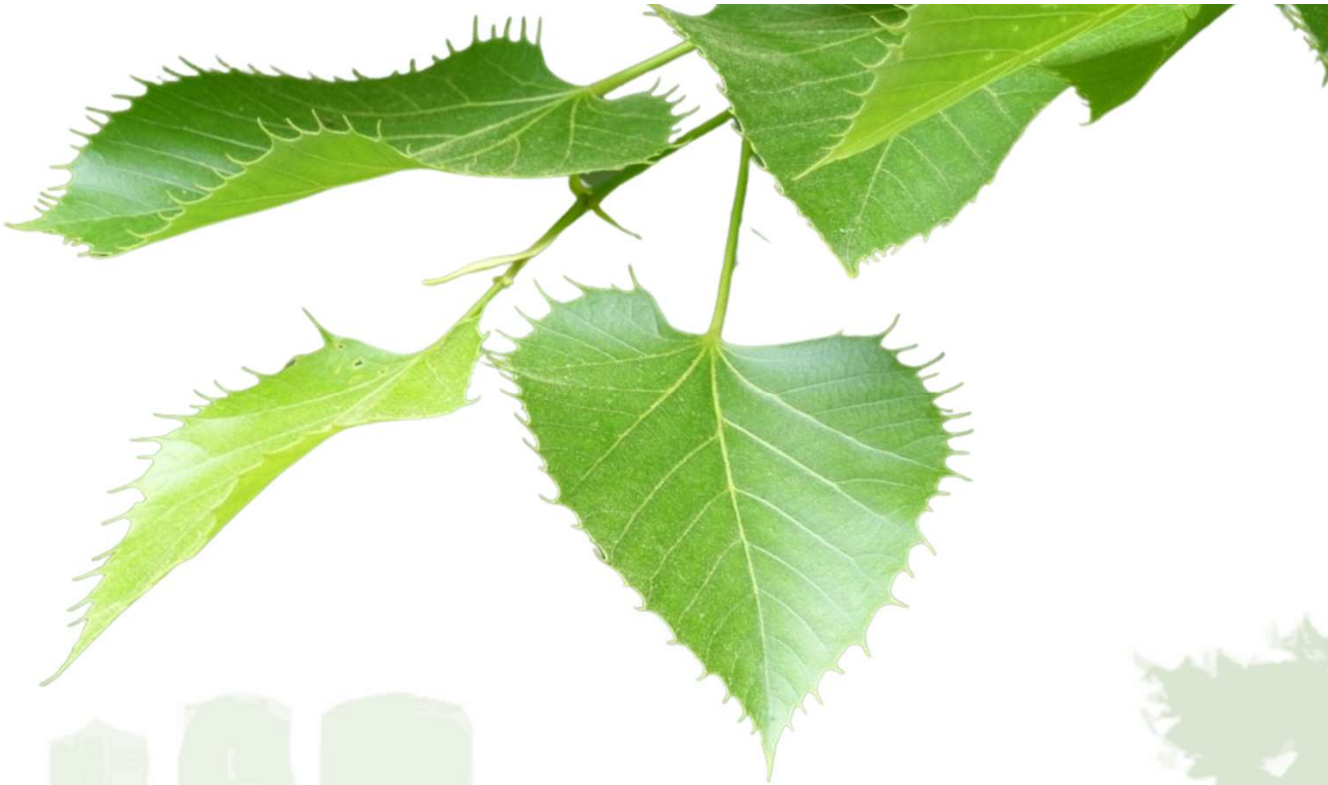
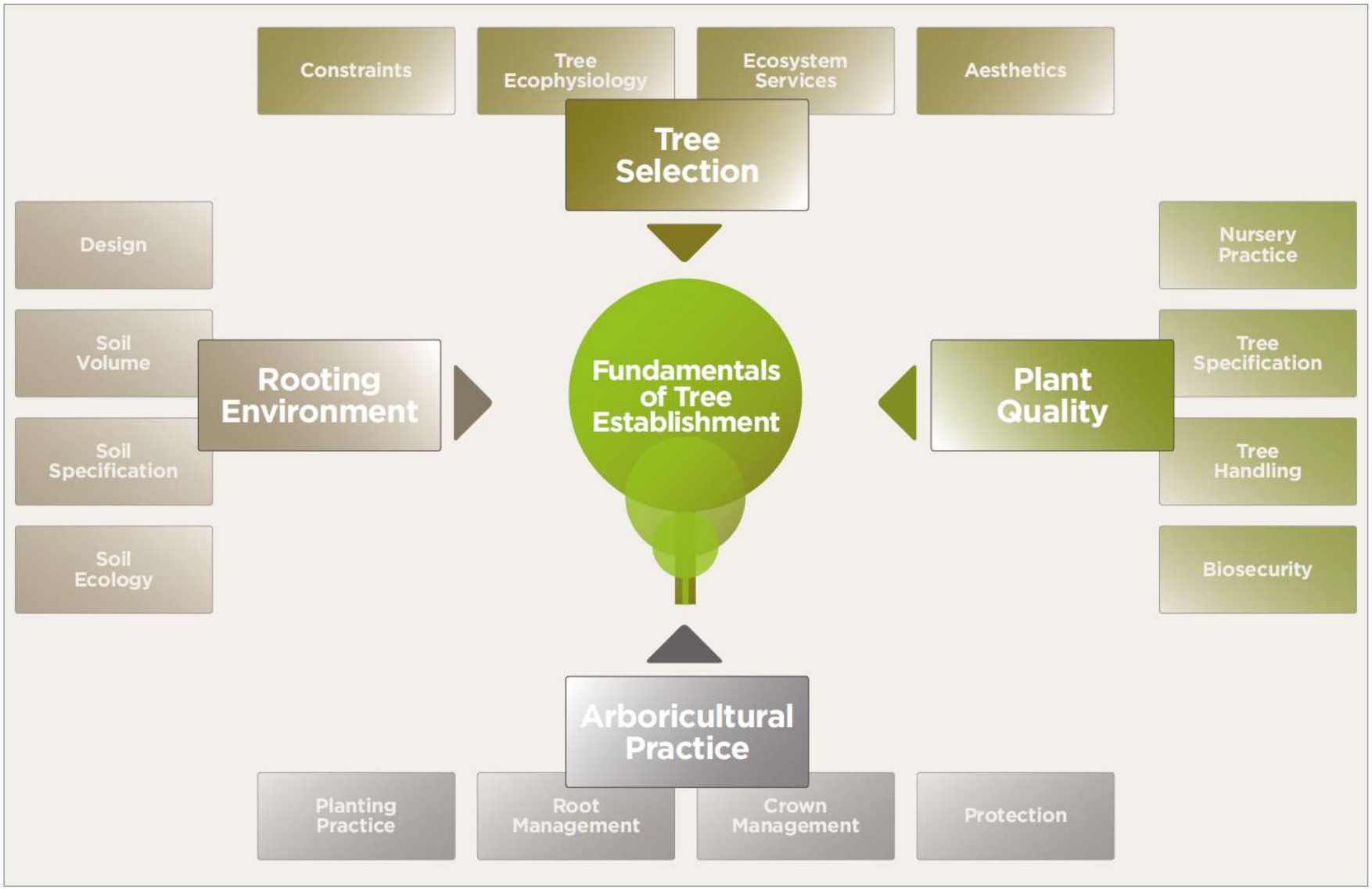
Springer

- 3 trees from their home;
- 30% tree canopy cover in each neighbourhood;
- 300 metres should be the maximum distance to the nearest high-quality public green space

Principle 10: Focus on establishment, not planting



- Policies that focus on number of trees planted or area of trees planted often have high failure rates. Focus on tree establishment!
- Employ specialists in young trees to help support establishment



Hirons and Sjöman (2018)