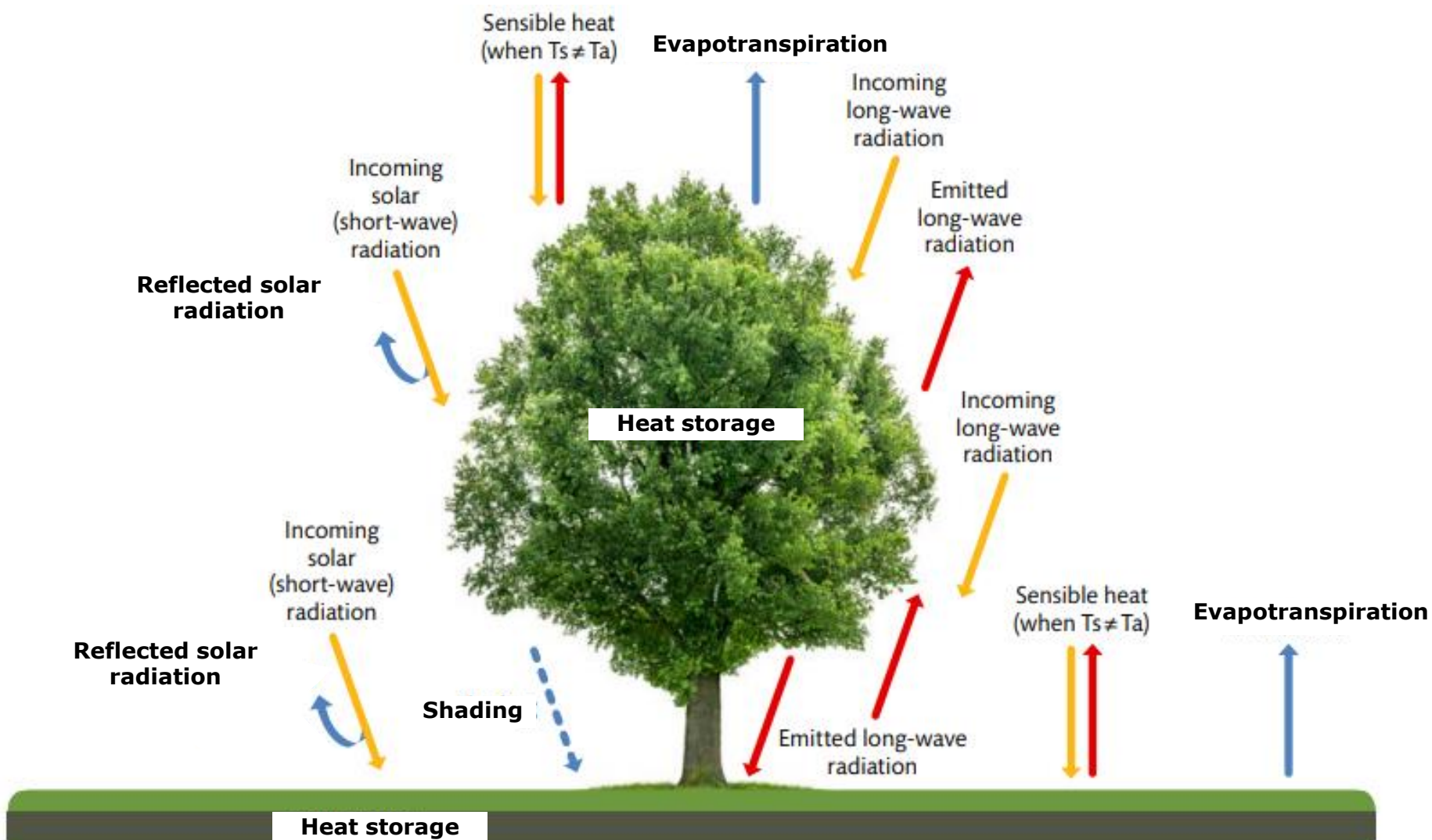
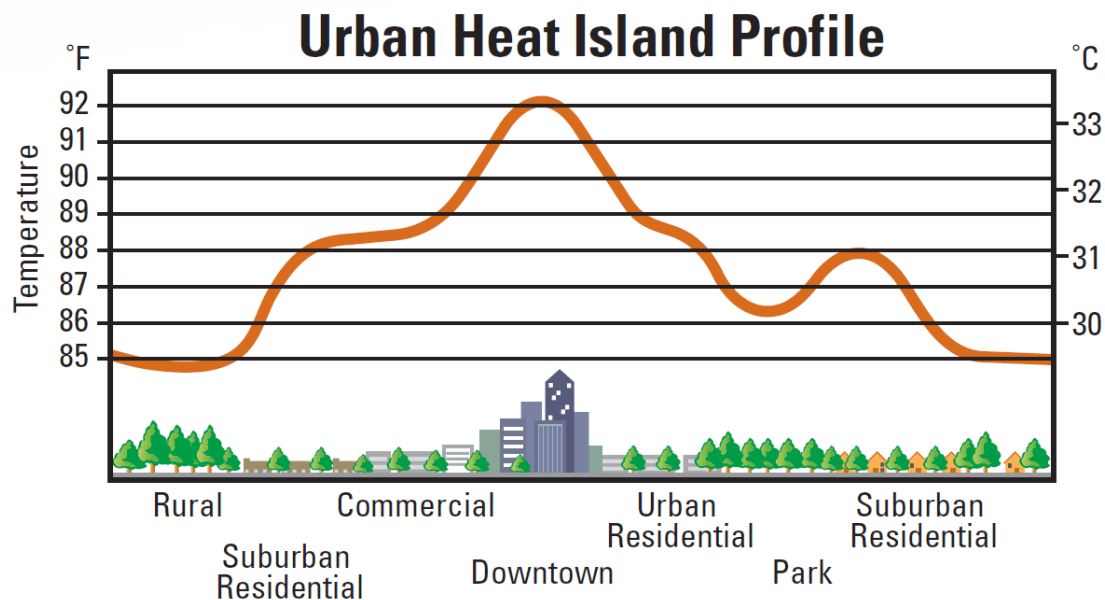


Trees influence climate and Climate influences trees

Madalena Vaz Monteiro
Urban Forest Research Group



Average air temperatures are higher in cities than in rural areas, particularly at night



Source: EPA, USA (2003)

UHI intensity at night is reported to be up to 7°C in Birmingham and 10°C in London

(Zhang et al., 2014. Progress in Physical Geography 38, 431–447; Doick et al., 2014. Science of the Total Environment 493: 662–671)

Air temperatures in cities can have serious implications for human health

- For every 1°C increase in air temperature above 21°C, heat-related deaths increase by 3%

(Hajat et al., 2002. Journal of Epidemiology and Community Health 56: 367-372)

- The number of heat-stress related deaths in the UK could more than double by the mid-century from a current baseline of 2,000

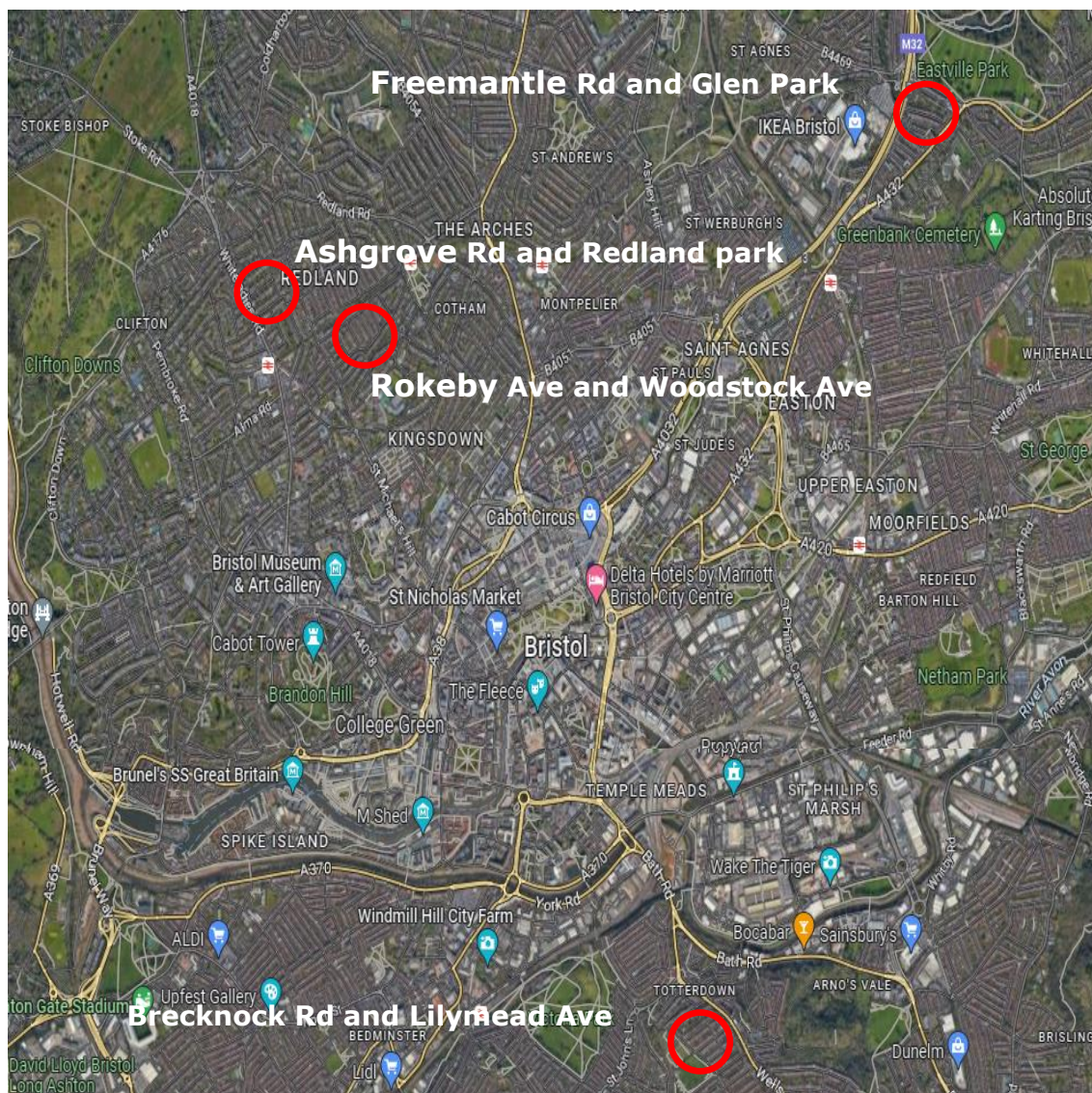
(Hajat et al., 2014. Journal of Epidemiology and Community Health 68, 641-648)



Street trees can significantly regulate daytime local air temperatures and improve resident's thermal comfort in hot periods.

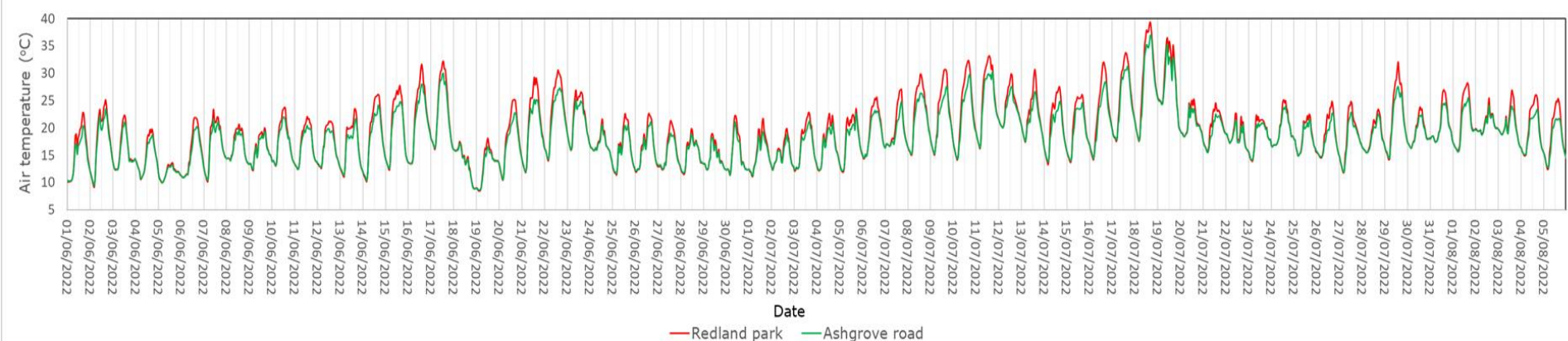
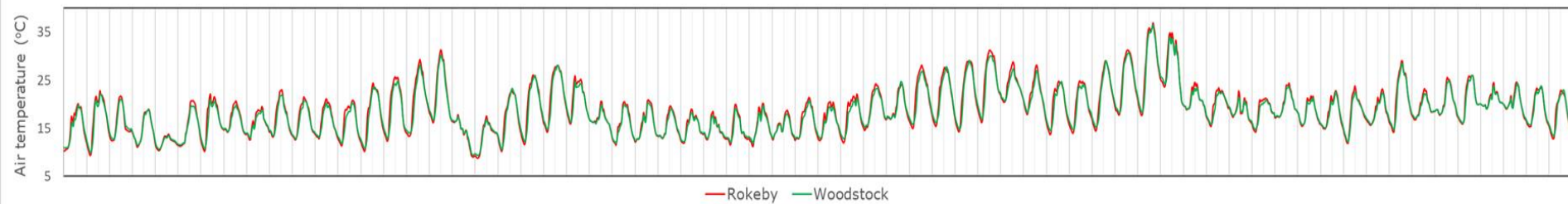
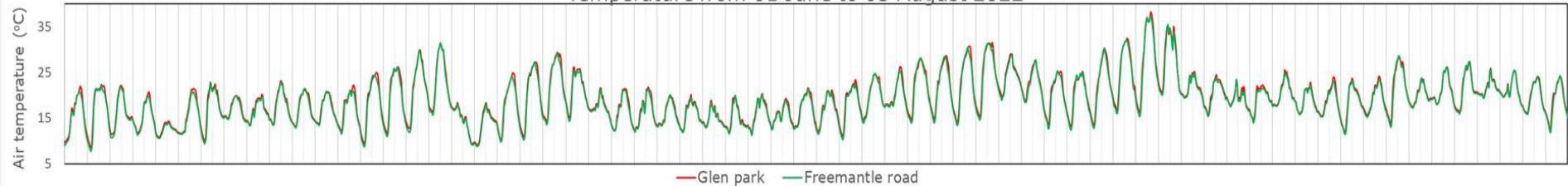
Not much evidence for their cooling effect in temperate climates.

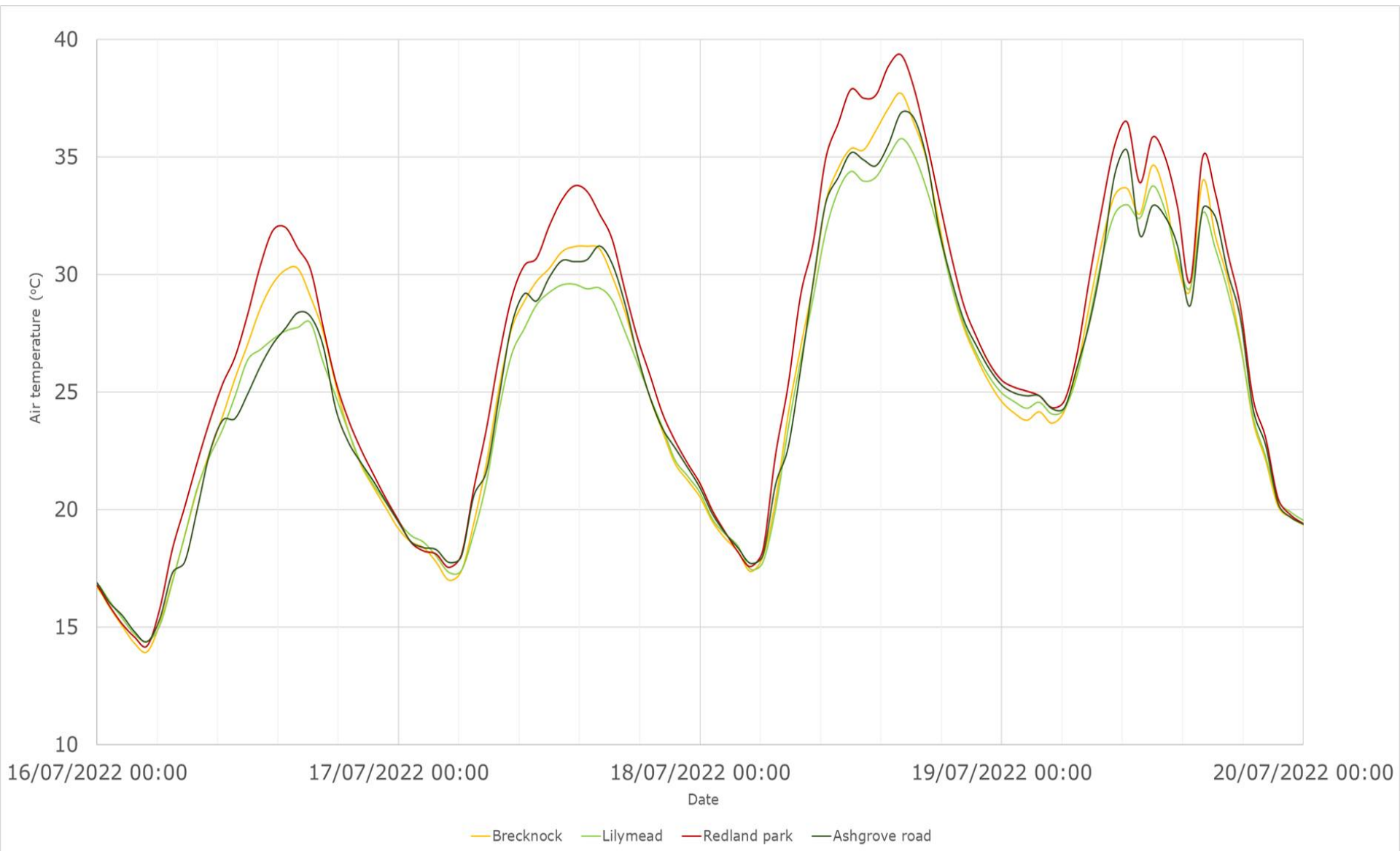
Sensors measuring air temperatures and humidity have been in place in Bristol streets since 2019.



Source: Goglemaps

Temperature from 01 June to 05 August 2022





British urban street trees are expected to be at risk from new threats in the near future

Climate change may create a more stressful environment for urban trees and favour the arrival of new pests and diseases

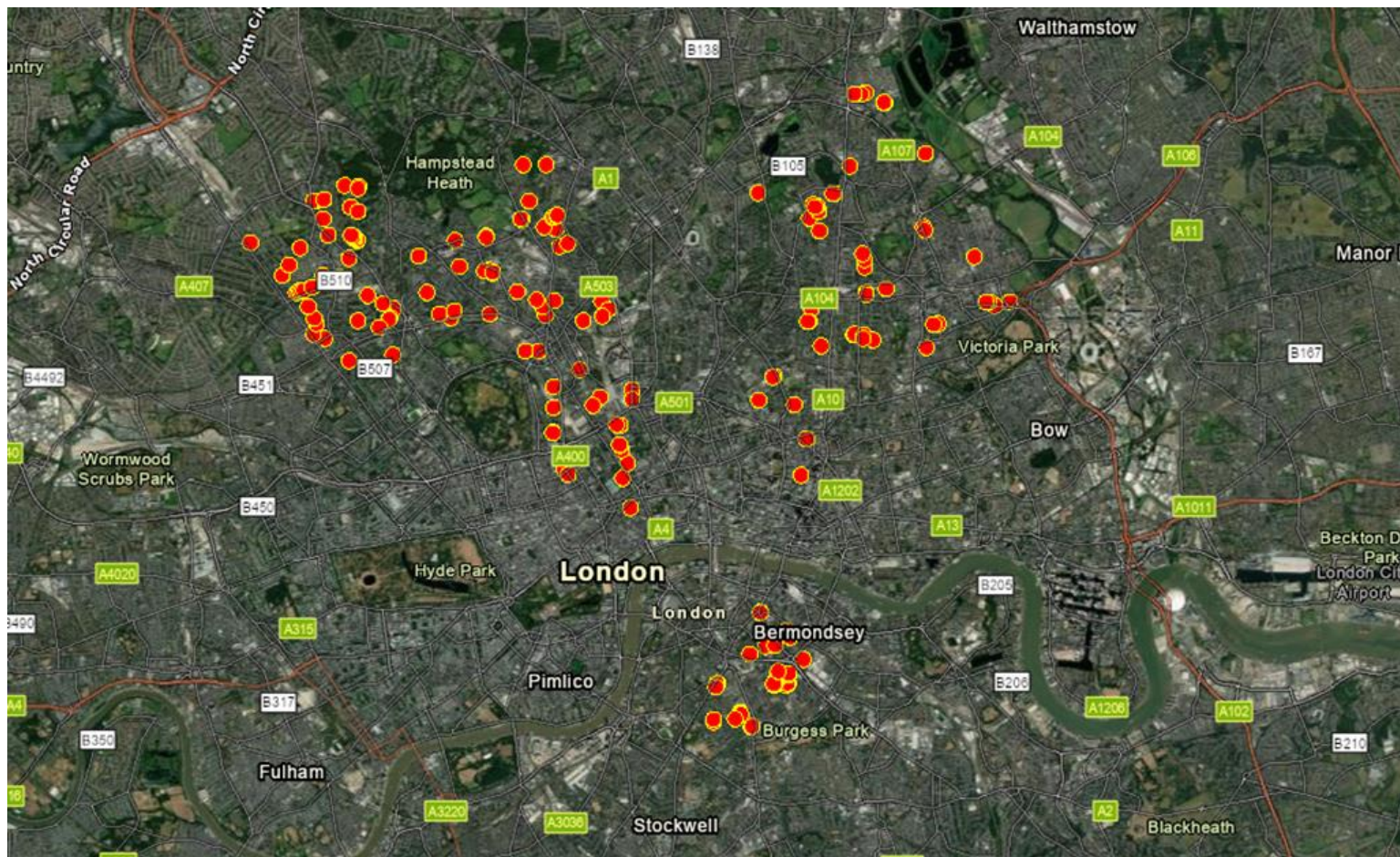
Diversity of tree species, genera and families is crucial!

Newly planted urban trees will only be able to offer optimal benefits to future generations if they thrive in an urban setting.

No data showcasing how underused species cope and develop (or not) within the street environment to help:

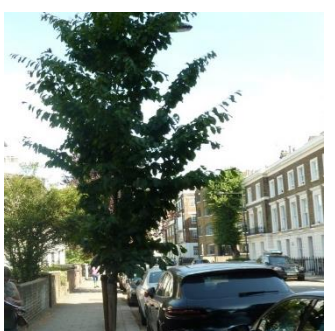
- Practitioners strategically plan their new plantings
- Tree nurseries plan their future stock

Long-term project following the growth of newly planted street trees from underused species



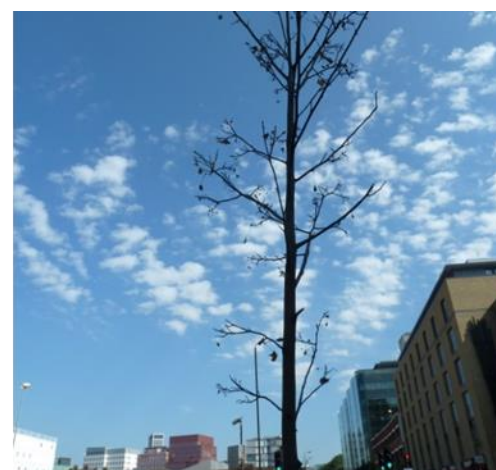
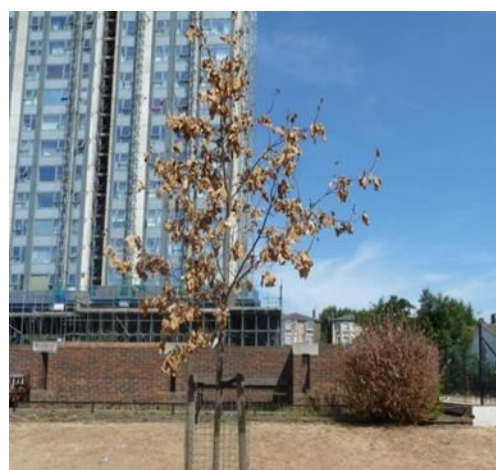
Earthstar Geographics | Esri UK, Esri, HERE, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS

| Species (inc. variety or cultivar) | Common name | Stature | Species native to: | Type | Family |
|---|---------------------|---------|--|-----------|-------------------|
| <i>Albizia julibrissin</i> | Persian silk tree | Small | Asia | Broadleaf | Fabaceae |
| <i>Carya illinoensis</i> | Pecan tree | Large | North and Central America | Broadleaf | Juglandaceae |
| <i>Cercidiphyllum japonicum</i> | katsura | Large | Asia | Broadleaf | Cercidiphyllaceae |
| <i>Cercis canadensis</i> 'Forest Pansy' | Judas Tree | Small | North America | Broadleaf | Fabaceae |
| x <i>Chitalpa taschkentensis</i> 'Summer Bells' | | Small | Hybrid from North American species | Broadleaf | Bignoniaceae |
| <i>Clerodendrum trichotomum</i> | Peanut butter tree | Small | Asia | Broadleaf | Lamiaceae |
| <i>Cornus kousa</i> 'Stellar Pink' | Kousa dogwood | Small | Hybrid - Asia | Broadleaf | Cornaceae |
| <i>Cornus mas</i> | Cornelian cherry | Small | South Europe and Southwestern Asia | Broadleaf | Cornaceae |
| <i>Euonymus europaeus</i> 'Red Cascade' | European spindle | Small | Europe (inc. UK) | Broadleaf | Celastraceae |
| <i>Hamamelis x intermedia</i> 'Jelena' | Hybrid witch hazel | Small | Hybrid from Asian species | Broadleaf | Hamamelidaceae |
| <i>Koelreuteria paniculata</i> | Pride of India | Small | Asia | Broadleaf | Sapindaceae |
| <i>Larix decidua</i> | European Larch | Large | Europe | Conifer | Pinaceae |
| <i>Liquidambar styraciflua</i> 'Gum ball' | Sweetgum | Small | North America | Broadleaf | Hamamelidaceae |
| <i>Liquidambar styraciflua</i> 'Worplesdon' | Sweetgum | Large | North America | Broadleaf | Hamamelidaceae |
| <i>Liriodendron tulipifera</i> | Tulip tree | Large | North America | Broadleaf | Magnoliaceae |
| <i>Magnolia grandiflora</i> | Evergreen magnolia | Large | North America | Broadleaf | Magnoliaceae |
| <i>Malus trilobata</i> | Lebanese wild apple | Small | Mediterranean to Middle East | Broadleaf | Rosaceae |
| <i>Metasequoia glyptostroboides</i> | Dawn Redwood | Large | Asia | Conifer | Cupressaceae |
| <i>Morus alba</i> | Mulberry | Large | Asia | Broadleaf | Moraceae |
| <i>Nyssa sylvatica</i> | Tupelo tree | Small | North America | Broadleaf | Nyssaceae |
| <i>Olea europaea</i> | Olive tree | Small | Mediterranean to Middle East | Broadleaf | Oleaceae |
| <i>Ostrya carpinifolia</i> | Hop hornbeam | Large | Mediterranean | Broadleaf | Betulaceae |
| <i>Parrotia persica</i> 'Vanessa' | Persian ironwood | Small | Middle East | Broadleaf | Hamamelidaceae |
| <i>Paulownia tomentosa</i> | Foxglove tree | Large | Asia | Broadleaf | Paulowniaceae |
| <i>Pinus nigra</i> | Corsican pine | Large | Europe | Conifer | Pinaceae |
| <i>Pinus sylvestris</i> | Scots pine | Large | Europe (inc. UK) | Conifer | Pinaceae |
| <i>Ulmus</i> 'Dodoens' | Hybrid Elm | Large | Hybrid from European and Asian species | Broadleaf | Ulmaceae |
| <i>Zelkova serrata</i> | Japanese zelkova | Large | Asia | Broadleaf | Ulmaceae |

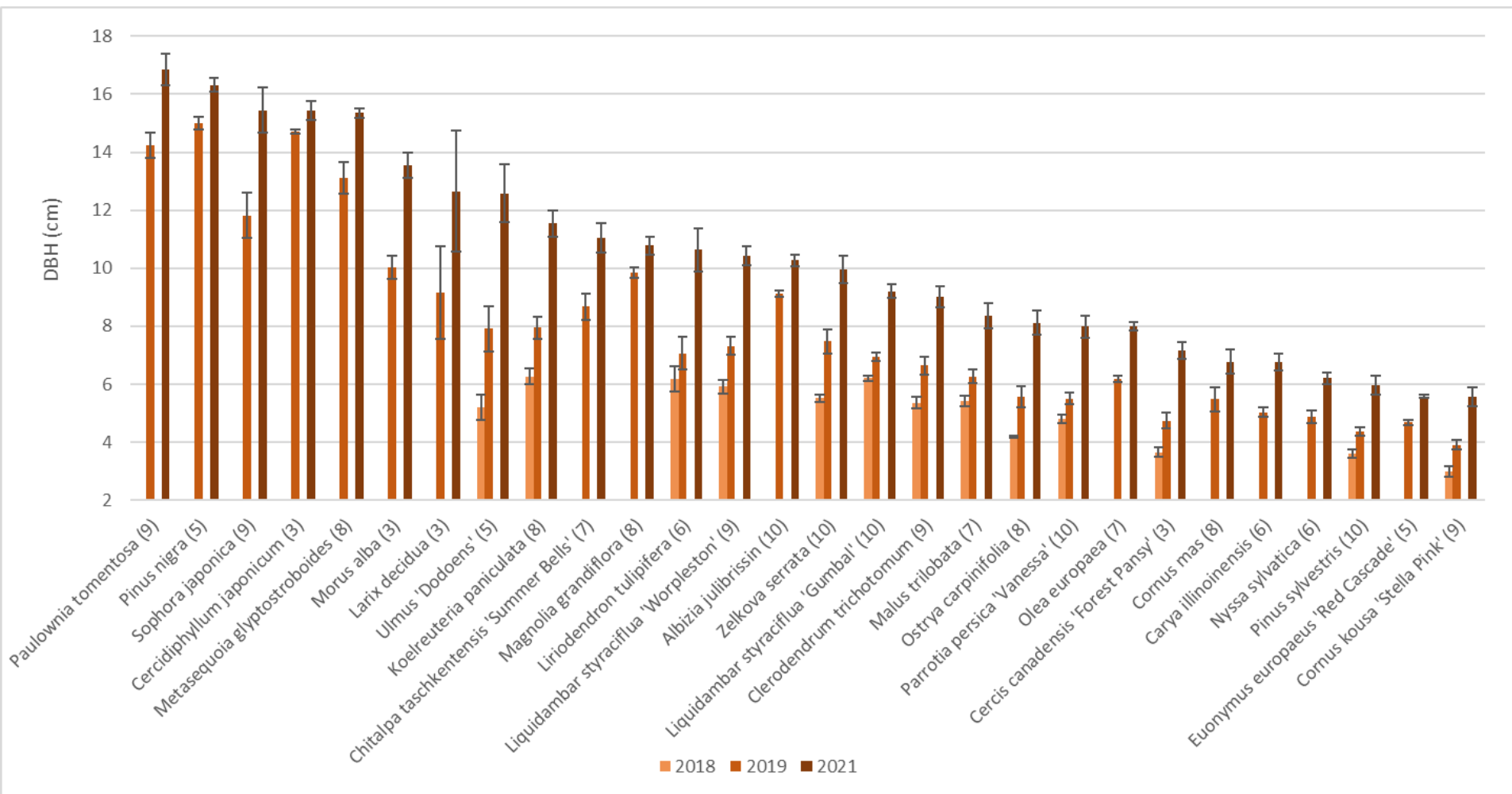


Number of trees per species either deemed dead or no longer found

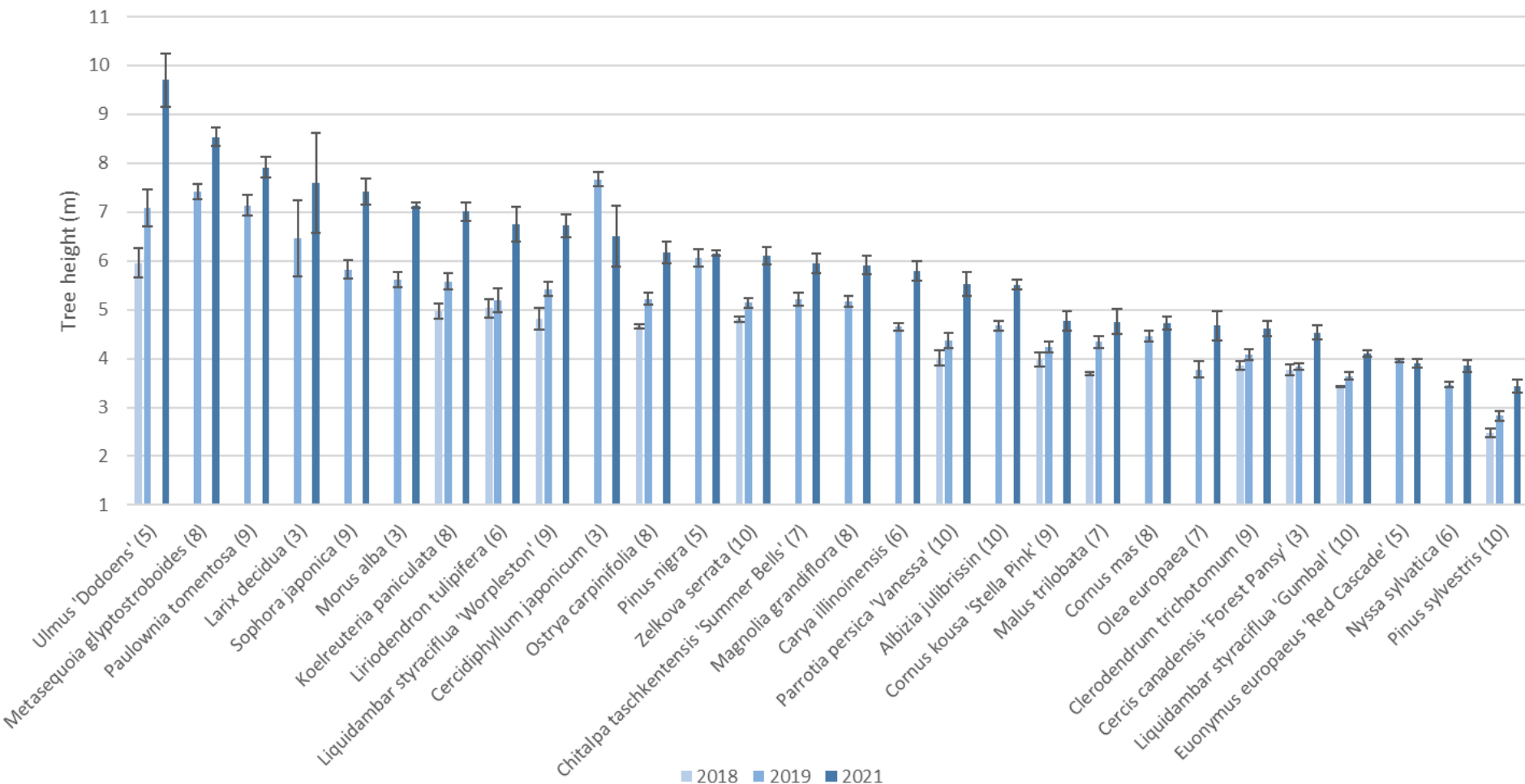
| Species | 2018 | 2019 | 2021 | Total lost trees |
|---|------|------|------|------------------|
| <i>Carya illinoensis</i> | | 1 | | 1 |
| <i>Cercidiphyllum japonicum</i> | | | 4 | 4 |
| <i>Cercis canadensis</i> 'Forest Pansy' | | | 4 | 4 |
| <i>Cornus kousa</i> 'Stella Pink' | 1 | | 1 | 2 |
| <i>Euonymus europaeus</i> 'Red Cascade' | | 2 | | 2 |
| <i>Hamamelis intermedia</i> 'Jelena' | 1 | 1 | 2 | 4 |
| <i>Koelreuteria paniculata</i> | | | 2 | 2 |
| <i>Larix decidua</i> | | | 2 | 2 |
| <i>Liquidambar styraciflua</i> 'Worplesdon' | | | 1 | 1 |
| <i>Liriodendron tulipifera</i> | 2 | 1 | | 3 |
| <i>Malus trilobata</i> | | | 1 | 1 |
| <i>Metasequoia glyptostroboides</i> | | 1 | | 1 |
| <i>Nyssa sylvatica</i> | | 2 | | 2 |
| TOTAL | 4 | 8 | 17 | 29 |



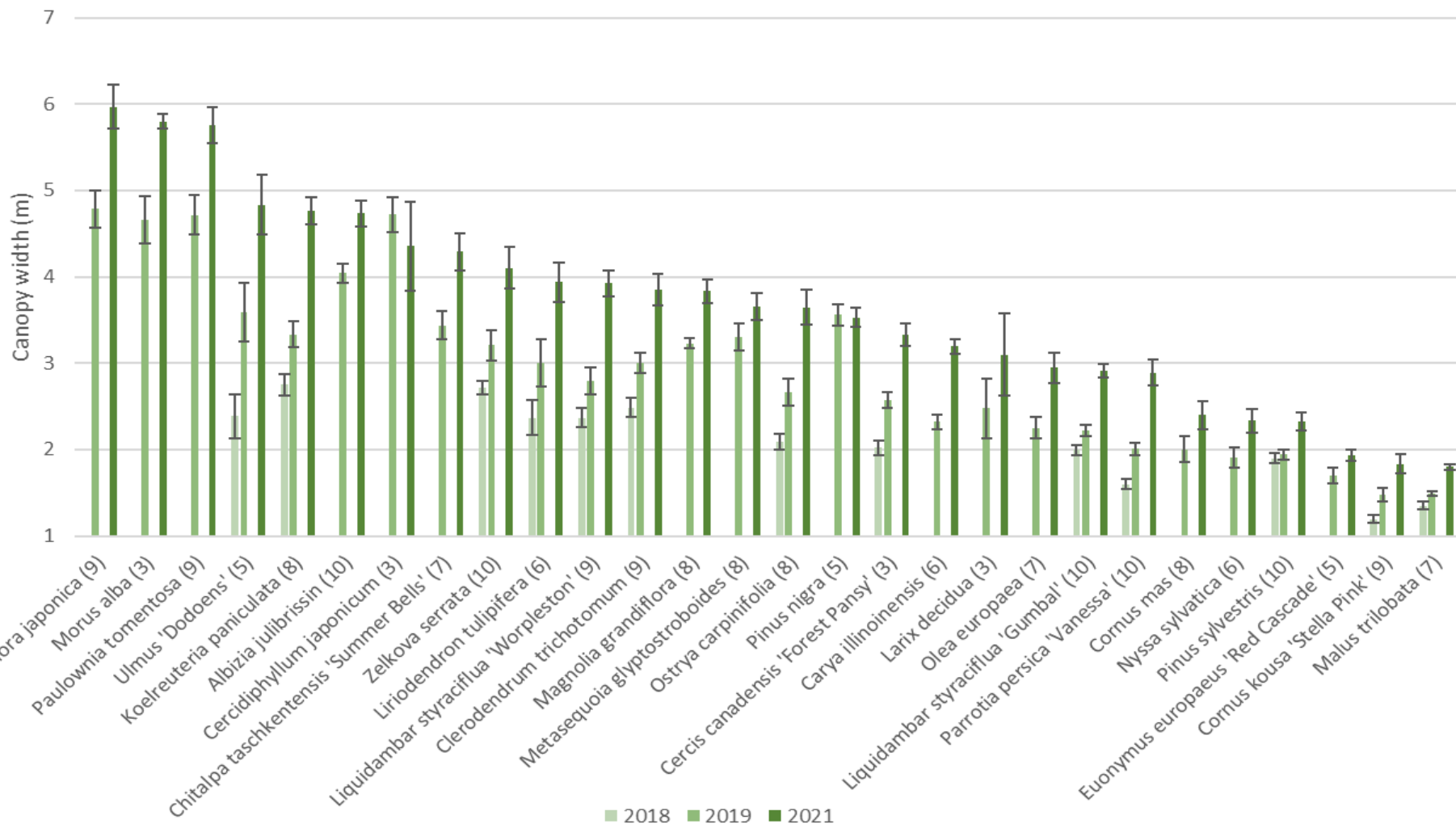
Mean trunk diameter for each species over the course of the survey



Mean tree heights for each species over the course of the survey



Mean canopy widths for each species over the course of the survey



Cooling by urban trees is present when needed the most!!!

The benefit that street trees can offer will depend on a range of factors such as:

- Tree species, canopy size/ density and tree arrangement within the street.
- Street/ building design, direction, sky view factor and topography.



We need to diversify our urban forests and select species that will tolerate the present and future urban climate!

Study is due to continue but trends are starting to emerge:

- Trees from 5 species appear to be growing vigorously: *Ulmus* 'Dodoens', *Sophora japonica*, *Koelreuteria paniculata*, *Liriodendron tulipifera* and *Morus alba*.
- Trees from 3 species have had limited tree growth combined with tree mortalities: *Hamamelis x intermedia* 'Jelena', *Cercidiphyllum japonicum* and *Euonymus europaeus* 'Red Cascade'.



Research was possible with help from:

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Madalena.VazMonteiro@forestresearch.gov.uk