Tree biology is central to decision making

Dr Andrew Hirons



URBAN PLANT LAB

University Centre Myerscough





THURSDAY 30 JULY 2026 WWW.INDEPENDENT.CO.UK

The INDEPENDENT

The Independent View PM has grasped the nettle of social care – but the sting remains in paying for it

Scorched earth Britain

- 'Flash drought' declared in half of England
- July set to be driest ever recorded
- Wisley, Surrey, sees 43 days with no rain
- Cairngorms wildfire burns for two weeks

» Pages 20-21

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POLITICS

France accuses Farage of 'violating sovereignty' over small boats plan

+ Kitty Donaldson The one statement that undermined Reform's whole project

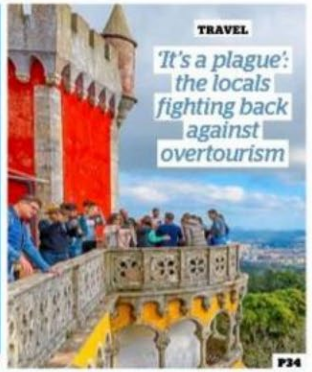
P6



SPORT

Infantino 'calling Trump' to try to salvage Fifa job

P5 & SPORT



TRAVEL

'It's a plague': the locals fighting back against overtourism

P24

INTERVIEW

Ruth Madeley

The Rapture and Dr Who star on sci-fi, sex and representing disability on screen



P38

PEOPLE

Send in the clones

How biohacker Bryan Johnson took immortality to the next level



P36



Driest July in 190 years

» England and Wales record driest July since records began in 1836

» Britain has second hottest July on record leading to drought and lower crop yields – but boost for solar power, with record electricity generation

» Firefighters battle wildfire the size of 210 football pitches in south Wales

» Water firms urged to go 'further and faster' to reduce leaks as ageing infrastructure loses 2.6bn litres a day – more than hosepipe bans would save

P10

HEALTH

The problem with protein washing

P17

CULTURE

Hey, Mr DJ

Andy Burnham played my club night



P25

OPINION

Trump has managed to unite the world... against him

P13

TV – THE BEST SHOWS TO WATCH IN AUGUST P41 | EDUCATION – REFORMS MAY LEAD TO FEWER GCSEs P9 | PUZZLES P27





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processed by ESA, CC BY-SA 3.0 IGO

If you can see me weep



A 'hunger stone' on the bank of the Elbe River in the Decin, Czech Republic. (Michal Cizek/AFP/Getty Images)

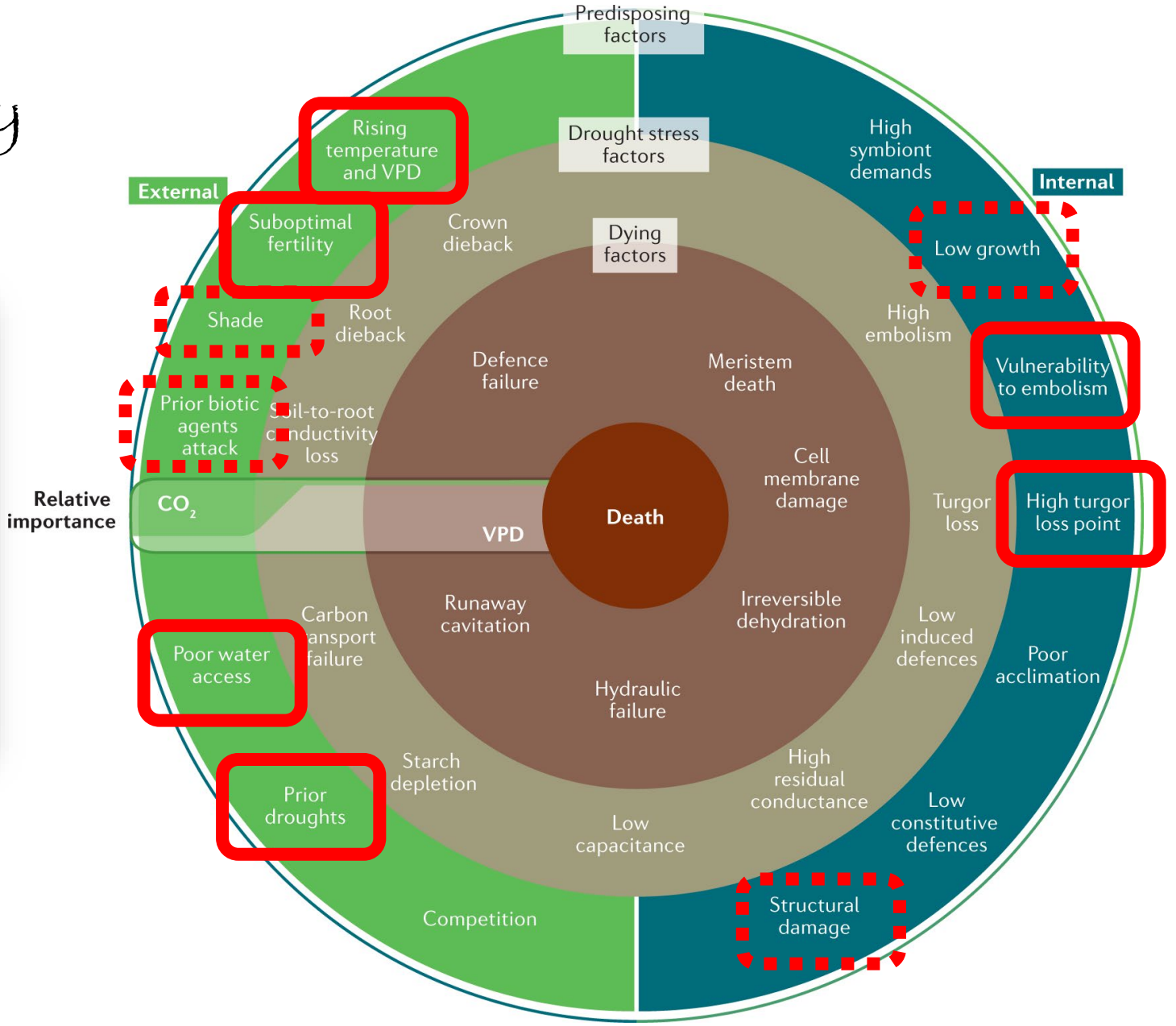
Drivers of tree mortality

REVIEWS

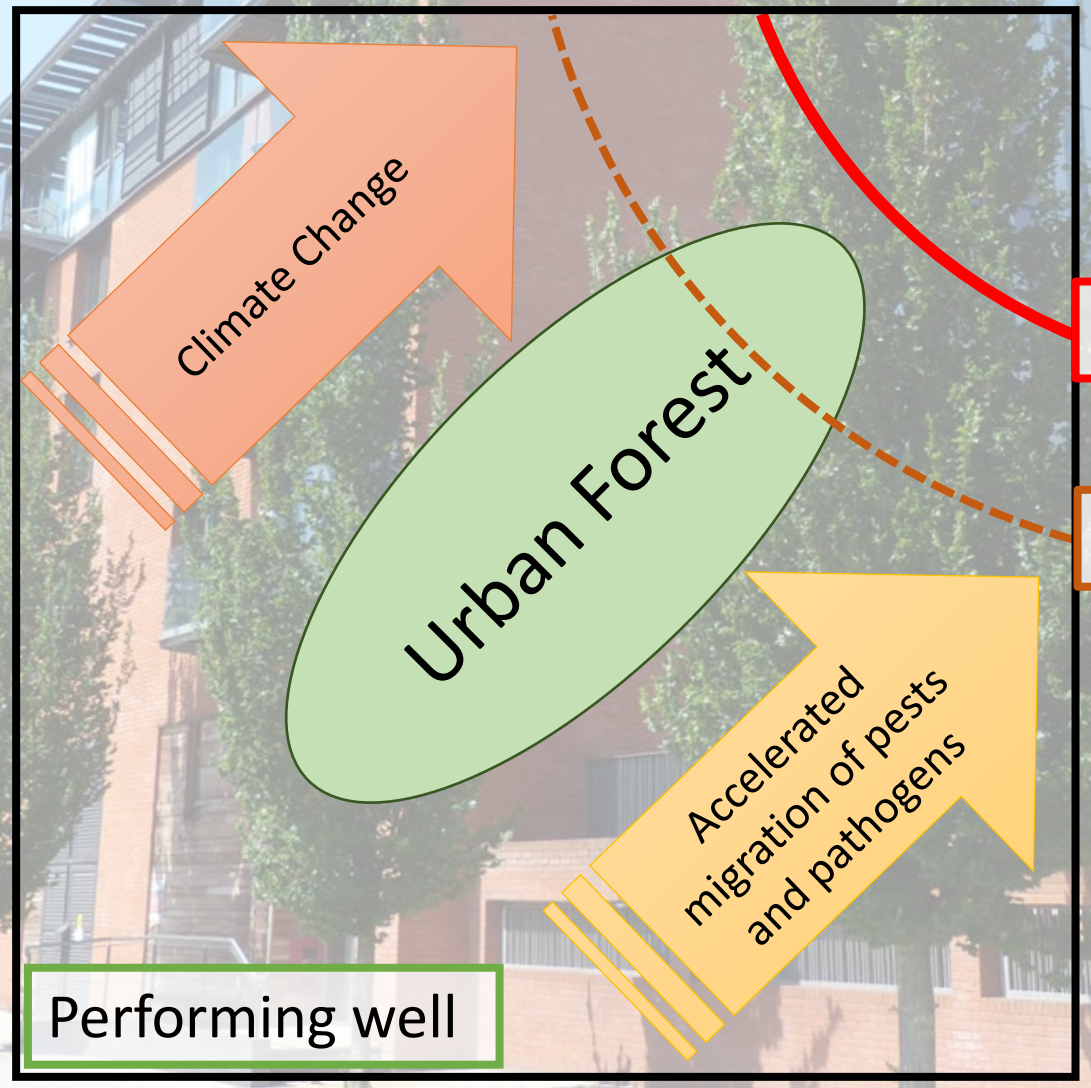
Check for updates

Mechanisms of woody-plant mortality under rising drought, CO_2 and vapour pressure deficit

Nate G. McDowell[1,2]✉, Gerard Sapes[3], Alexandria Pivovaroff[1], Henry D. Adams[4], Craig D. Allen[5], William R. L. Anderegg[6], Matthias Arend[7], David D. Breshears[8], Tim Brodribb[9], Brendan Choat[10], Hervé Cochard[11], Miquel De Cáceres[12], Martin G. De Kauwe[13,14,15], Charlotte Grossiord[16,17], William M. Hammond[18], Henrik Hartmann[19], Günter Hoch[7], Ansgar Kahmen[7], Tamir Klein[20], D. Scott Mackay[21,22], Marylou Mantova[11], Jordi Martínez-Vilalta[12,23], Belinda E. Medlyn[10], Maurizio Mencuccini[12,24], Andrea Nardini[25], Rafael S. Oliveira[26], Anna Sala[27], David T. Tissue[10], José M. Torres-Ruiz[11], Amy M. Trowbridge[28], Anna T. Trugman[29], Erin Wiley[30] and Chonggang Xu[31]



Strategic challenges for the urban forest



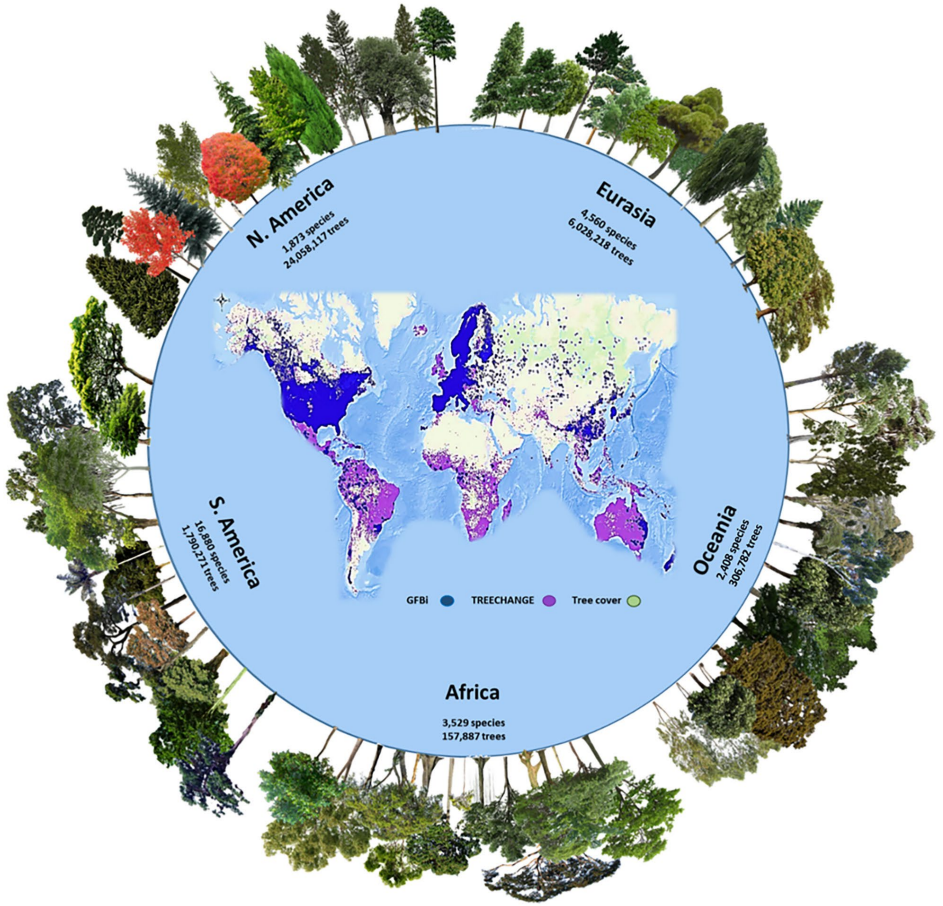
Species selection is critical to these challenges

About 73,000 tree species globally

The number of tree species on Earth

Roberto Cazzolla Gatti[a,b,c], Peter B. Reich[d,e,f,1], Javier G. P. Gamarra[g], Tom Crowther[h], Cang Hui[i,j], Albert Morera[k,l], Jean-Francois Bastin[m], Sergio de-Miguel[k,l], Gert-Jan Nabuurs[n], Jens-Christian Svenning[o,p], Josep M. Serra-Diaz[q], Cory Merow[r], Brian Enquist[s], Maria Kamenetsky[t], Junho Lee[u], Jun Zhu[v], Jinyun Fang[w], Douglass F. Jacobs[a], Bryan Pijanowski[a], Arindam Banerjee[x], Robert A. Giaquinto[y], Giorgio Alberti[z,aa], Angelica Maria Almeyda Zambrano[bb], Esteban Alvarez-Davila[cc], Alejandro Araujo-Murakami[dd], Valerio Avitabile[ee], Gerardo A. Aymard[ff,gg], Radomir Balazy[hh], Chris Baraloto[ii], Jorcely G. Barroso[jj], Meredith L. Bastian[kk,ll], Philippe Birnbaum[mm,nn], Robert Bitariho[oo], Jan Bogaert[m], Frans Bongers[n], Olivier Bouriaud[pp], Pedro H. S. Brancalion[qq], Francis Q. Brearley[rr], Eben North Broadbent[ss], Filippo Bussotti[tt], Wendeson Castro da Silva[uu,vv], Ricardo Gomes César[qq], Goran Češljar[ww], Víctor Chama Moscoso[xx], Han Y. H. Chen[yy], Emil Cienciala[zz,aaa], Connie J. Clark[bbb], David A. Coomes[ccc], Selvadurai Dayanandan[ddd], Mathieu Decuyper[eee,fff], Laura E. Dee[ggg], Jhon Del Aguila Pasquel[hhh], Géraldine Derroire[iii], Marie Noel Kamdem Djuikouo[jjj], Tran Van Do[kkk], Jiri Dolezal[lll,mmm], Ilija Đ. Đorđević[ww], Julien Engel[nnn], Tom M. Fayle[ooo], Ted R. Feldpausch[ppp], Jonas K. Fridman[qqq], David J. Harris[rrr], Andreas Hemp[sss], Geerten Hengeveld[ttt], Bruno Herault[uuu,vvv,www], Martin Herold[xxx,yyy], Thomas Ibanez[zzz,aaaa], Andrzej M. Jagodzinski[bbbb], Bogdan Jaroszewicz[cccc], Kathryn J. Jeffery[dddd], Vivian Kvist Johannsen[eeee], Tommaso Jucker[ffff], Ahto Kangur[gggg], Victor N. Karminov[hhhh], Kuswata Kartawinata[iiii,jjjj], Deborah K. Kennard[kkkk], Sebastian Kepfer-Rojas[llll], Gunnar Keppel[mmmm], Mohammed Latif Khan[nnnn], Pramod Kumar Khare[oooo], Timothy J. Kileen[pppp], Hyun Seok Kim[qqqq,rrrr,ssss,tttt], Henn Korjus[gggg], Amit Kumar[uuuu], Ashwani Kumar[vvvv], Diana Laarmann[gggg], Nicolas Labrière[wwww], Mait Lang[gggg,xxxx], Simon L. Lewis[yyyy,zzzz], Natalia Lukina[hhhh], Brian S. Maitner[aaaaa], Yadvinder Malhi[bbbbb], Andrew R. Marshall[ccccc,ddddd], Olga V. Martynenko[eeeee], Abel L. Monteagudo Mendoza[fffff], Petr V. Ontikov[ggggg], Edgar Ortiz-Malavasi[hhhhh], Nadir C. Pallqui Camacho[iiiii], Alain Paquette[iiiii], Minjee Park[a], Narayanaswamy Parthasarathy[kkkkk], Pablo Luis Peri[lllll], Pascal Petronelli[mmmmm], Sebastian Pfautsch[nnnnn], Oliver L. Phillips[yyyy], Nicolas Picard[g,ooooo], Daniel Piotto[ppppp], Lourens Poorter[n], John R. Poulsen[bbb], Hans Pretzsch[qqqqq], Hirma Ramírez-Angulo[rrrrr], Zorayda Restrepo Correa[sssss], Mirco Rodeghiero[ttttt,uuuuu], Rocío Del Pilar Rojas Gonzáles[vvvvv], Samir G. Rolim[wwwww], Francesco Rovero[xxxxx,yyyyy], Ervan Rutishauser[zzzzz], Purabi Saikia[aaaaaa], Christian Salas-Eljatib[bbbbbb,cccccc,dddddd], Dmitry Schepaschenko[eeeeee,ffffff], Michael Scherer-Lorenzen[ggggggg], Vladimír Šebeň[hhhhhh], Marcos Silveira[iiiiii], Ferry Slik[jjjjjj], Bonaventure Sonké[kkkkkk], Alexandre F. Souza[llllll], Krzysztof Jan Stereńczak[mmmmmm], Miroslav Svoboda[nnnnnn], Hermann Taedoumg[oooooo,pppppp], Nadja Tchebakova[eeeeee], John Terborgh[qqqqqq,rrrrrr], Elena Tikhonova[hhhh], Armando Torres-Lezama[ssssss], Fons van der Plas[tttttt], Rodolfo Vásquez[vvvvv], Helder Viana[uuuuuu,vvvvvv], Alexander C. Vibrans[wwwwww], Emilio Vilanova[xxxxxx], Vincent A. Vos[yyyyyy], Hua-Feng Wang[zzzzzz], Bertil Westerlund[aaaaaaa], Lee J. T. White[bbbbbbb,ccccccc,ddddddd], Susan K. Wiser[eeeeeee], Tomasz Zawiła-Niedźwiecki[fffffff], Lise Zemagho[kkkkkk], Zhi-Xin Zhu[ggggggg], Irié C. Zo-Bi[hhhhhhh], and Jingjing Liang[a,1]

ECOLOGY

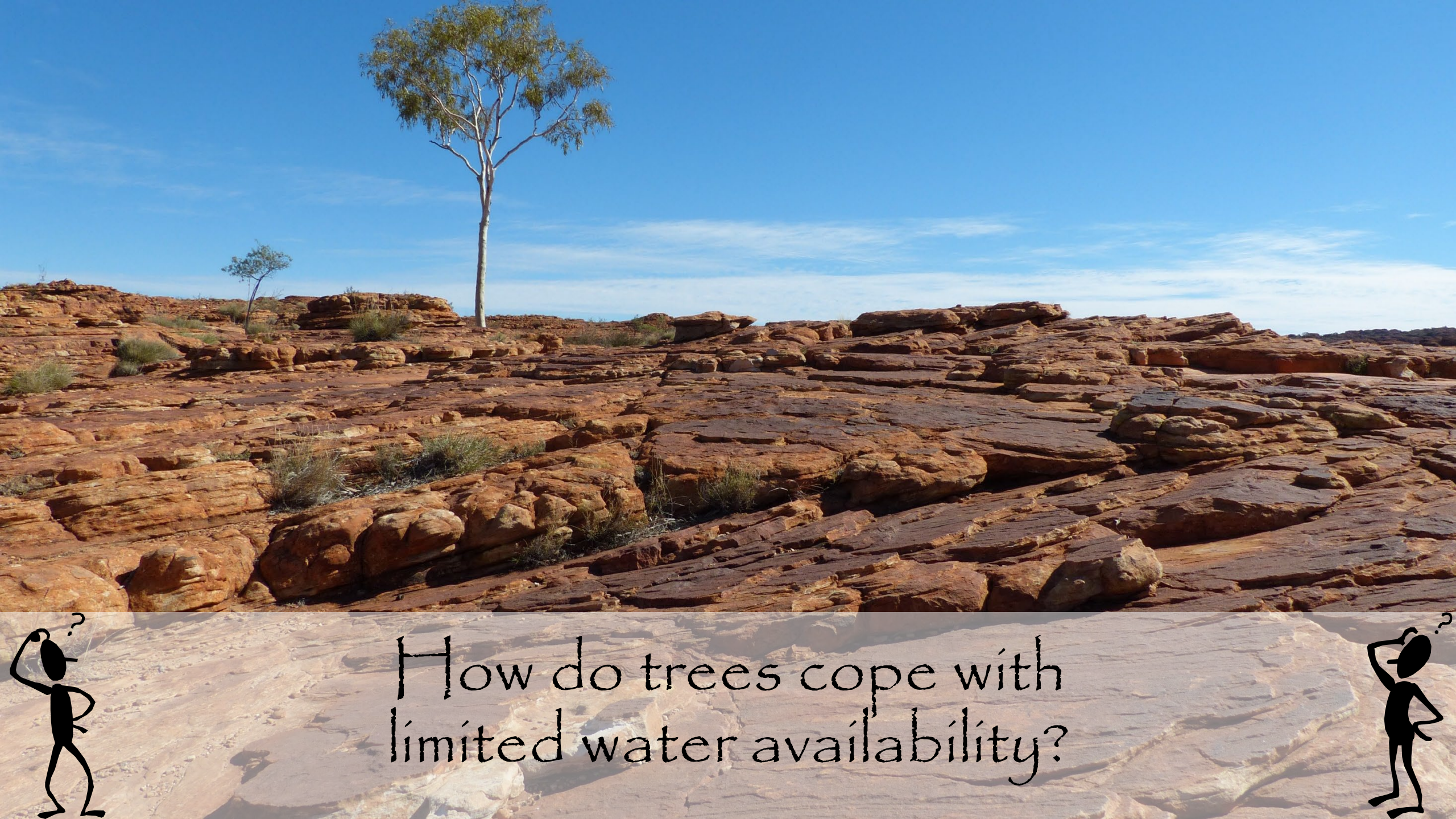


Cazzolla Gatti *et al.,* (2022) *PNAS* Vol. 119 No. 6

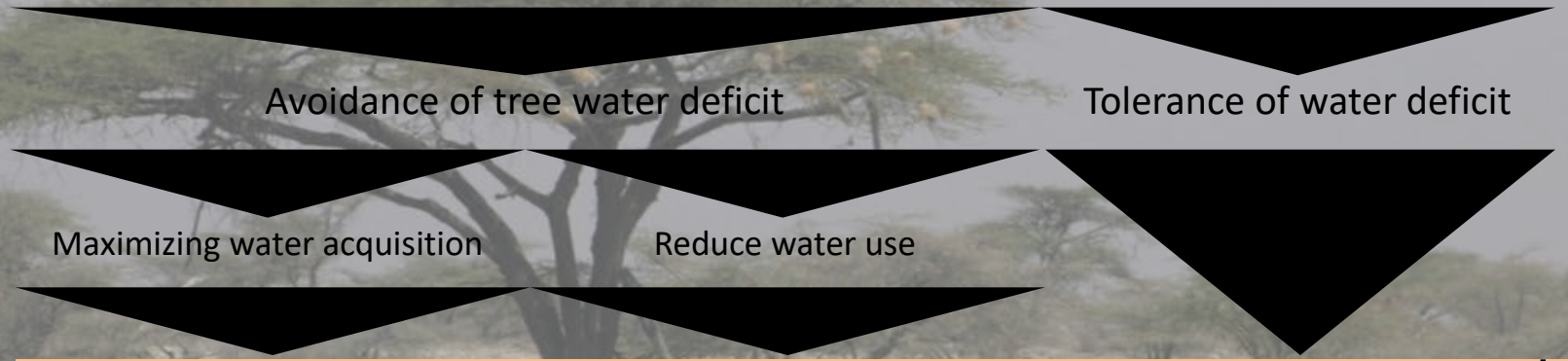
Improving selection decisions

- Trait based assessment
- Ecophysiological strategies
- Biogeographical data analysis (e.g. SDMs)




How do trees cope with limited water availability?

Adaptations to limited water availability



Increased hydraulic conductivity	Stomatal closure	Osmotic adjustment Low turgor loss point	Physiological
Deep rooting Root proliferation	Reduced leaf and stem growth Increased resistance to leaf water loss	Resistance to drought-induced cavitation	Structural
	Leaf phenology Leaf abscission		Life cycle

Hirons and Thomas 2018

Avoid ‘avoiders’ for the challenging sites



Tilia x *euchlora*

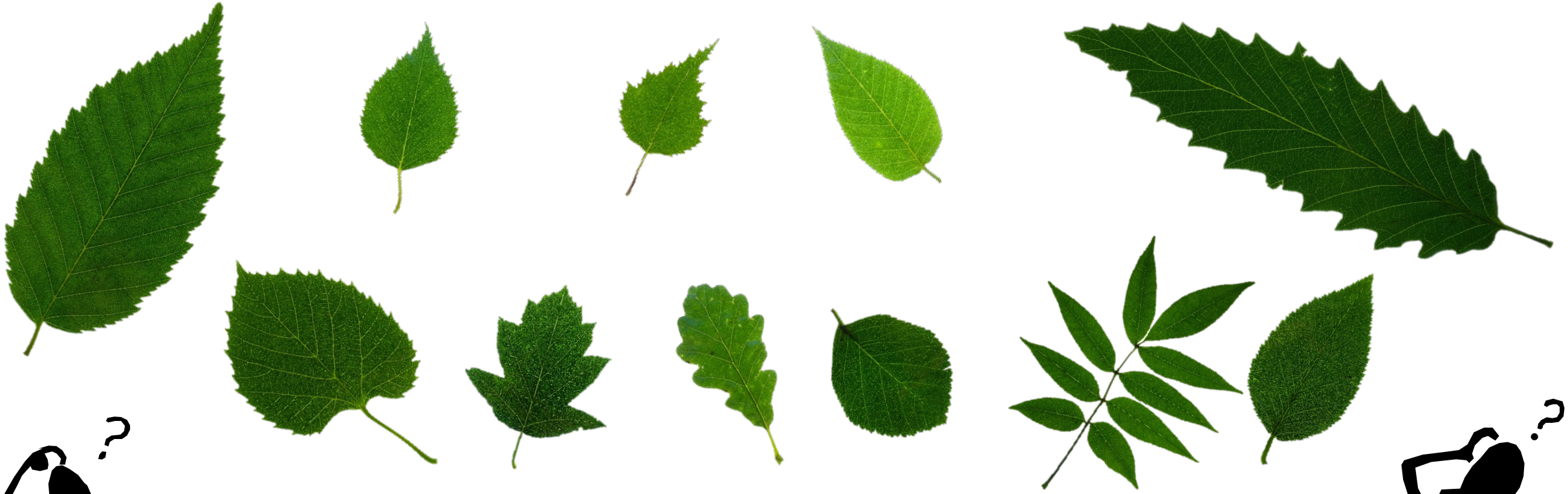


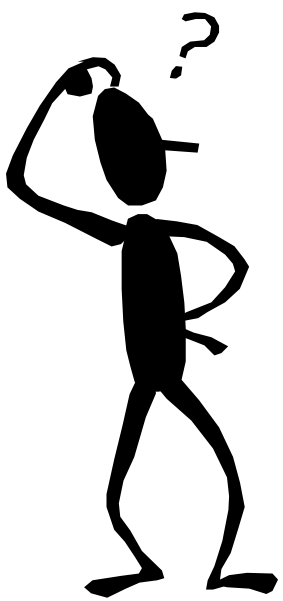
Betula utilis

Drought tolerant trees have an inherent resilience to water deficits

- Able to extract water from the soil for longer during a drying cycle
- Maintain physiological activity for longer
  - Carbon gain
  - Transpiration > Evaporative cooling
- Will perform better as landscape trees on challenging sites







How can we select for drought tolerance?




Marschner's Mineral Nutrition of Higher Plants
Van Pelt ▲ Forest Giants of the Pacific Coast
Trees & Shrubs
TREES for gardens, orchards and permaculture
STEPPES
Routledge Handbook of Urban Forestry
Trees of Eastern North America
Trees of Western North America
The Urban Forest
Flowering Cherries
Wurzelatlas
TREES IN CANADA
Trees for All Seasons
BROADLEAVED EVERGREENS FOR TEMPERATE CLIMATES
SEAN HOGAN
Physiological Ecology of Tropical Plants
Hawthorns and Medlars
MAPLES
TALES FROM THE WOODS
TREES FOR AMERICAN GARDENS
NORTH AMERICA
Trees for Society and the Environment
Tree Statics and Tree Inspection
URBAN TREE MANAGEMENT
Keddy PLANT ECOLOGY
FOREST TREES OF THE PACIFIC SLOPE
TRÄD I URBANA LANDSKAP
STADSTRÄDSLEXIKON
TREASURY of TREES
OAKS of CALIFORNIA
WOODY SHRUBS AND TREES
PLANTS OF CHINA
THE TREES OF SONORA, MEXICO
LANDSCAPE PLANTS OF ARABIA
JULIAN LEE
TREES FOR THE SMALL GARDEN
NATIVE TREES for NORTH AMERICAN LANDSCAPES
LANDSCAPE PLANTS FOR EASTERN NORTH AMERICA
Native Trees, Shrubs and Vines for Urban and Rural America
Forest Vegetation of Northeast Asia
ECOSYSTEMS OF THE WORLD 15 FORESTED WETLANDS
ECOSYSTEMS OF THE WORLD 10 TEMPERATE BROAD-LEAVED EVERGREEN FORESTS
ECOSYSTEMS OF THE WORLD 6 CONIFEROUS FORESTS
ECOSYSTEMS OF THE WORLD 7 TEMPERATE DECIDUOUS FORESTS
TREES & SHRUBS HARDY IN THE BRITISH ISLES W.J. BEAN EIGHTH EDITION JOHN MURRAY
THE SECRET LIFE OF TREES COLIN TUDGE
Ladders to Heaven
TREE GUIDE
New Trees
Recent Introductions to Cultivation
John Grimshaw
Ross Bayton
Kew
ENCYCLOPEDIA OF TREES & SHRUBS

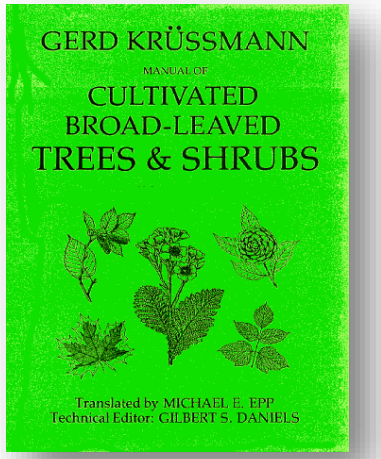
Advice from literature...

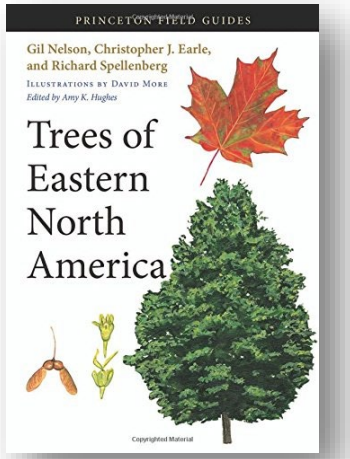


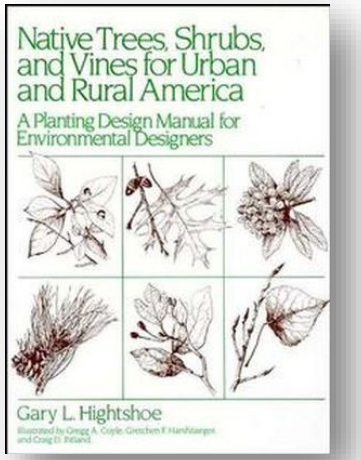
Male flower of *Acer negundo* (Duncan Slater)

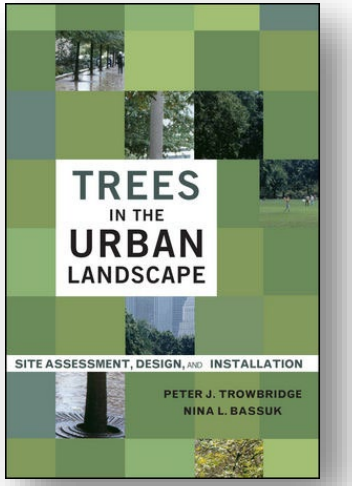
Acer negundo

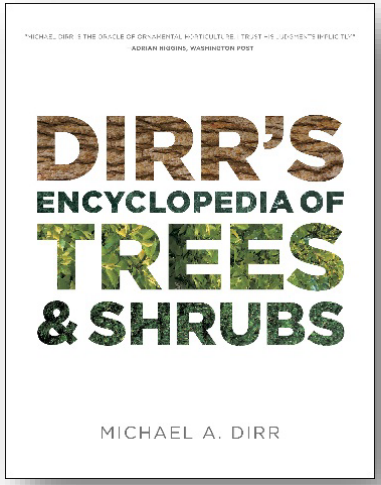
- Useful for sandy, dry to sterile soil (Krüssmann 1982)
- Drought tolerant (Stoecklein 2001)
- Its native habitat is along streams and ponds (Grimm 2002)
- Native in moist habitats but performs well also in poor, wet, or dry habitats (Dirr 2009)
- Very heat and drought tolerant (Hightshoe 1988)
- Grows along shores of permanent bodies of water (Krüssmann, 1986)
- Likes humid areas (Beaulieu 2003)
- Grows along stream banks, flood plains, swamps (Nelson et al. 2014)

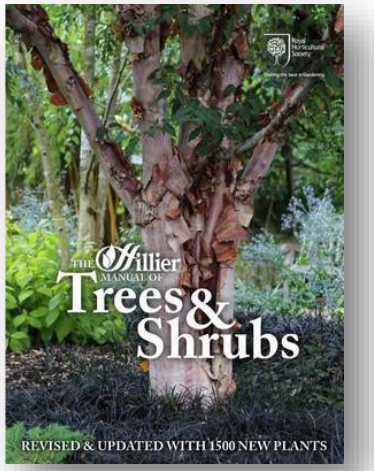


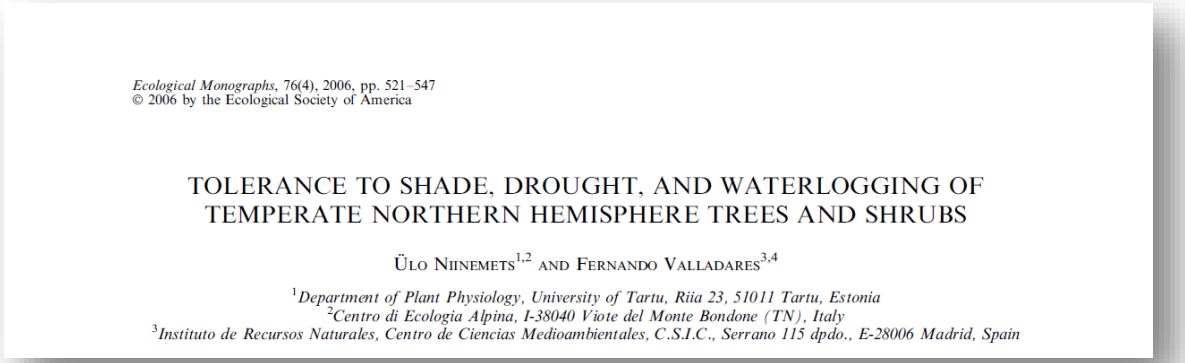












Ecological Monographs, 76(4), 2006, pp. 521–547
© 2006 by the Ecological Society of America

TOLERANCE TO SHADE, DROUGHT, AND WATERLOGGING OF TEMPERATE NORTHERN HEMISPHERE TREES AND SHRUBS

Ülo Niinemets[1,2] and Fernando Valladares[3,4]

[1]*Department of Plant Physiology, University of Tartu, Riia 23, 51011 Tartu, Estonia*
[2]*Centro di Ecologia Alpina, I-38040 Viote del Monte Bondone (TN), Italy*
[3]*Instituto de Recursos Naturales, Centro de Ciencias Medioambientales, C.S.I.C., Serrano 115 dpdo., E-28006 Madrid, Spain*

Drought Tolerance Index

Scale ranking	Annual precipita… (m…	Distri…		Soil water …tial (MPa)	Duration of dry period
1					A few days
2				-0.8	A few weeks
3	4…			-0.8 to -1.5	Up to a month
4	300-400	20-25%	0.5:0.8	-1… -3	Two to three months
5	<300	>25%	<0.5	< -3	More than three months

But, does survival equal performance in our urban landscapes?

Adapted from: Niinemets and Valladares 2006

Using plant traits – PLC / P_{50}

LETTER

doi:10.1038/nature11688

Global convergence in the vulnerability of forests to drought

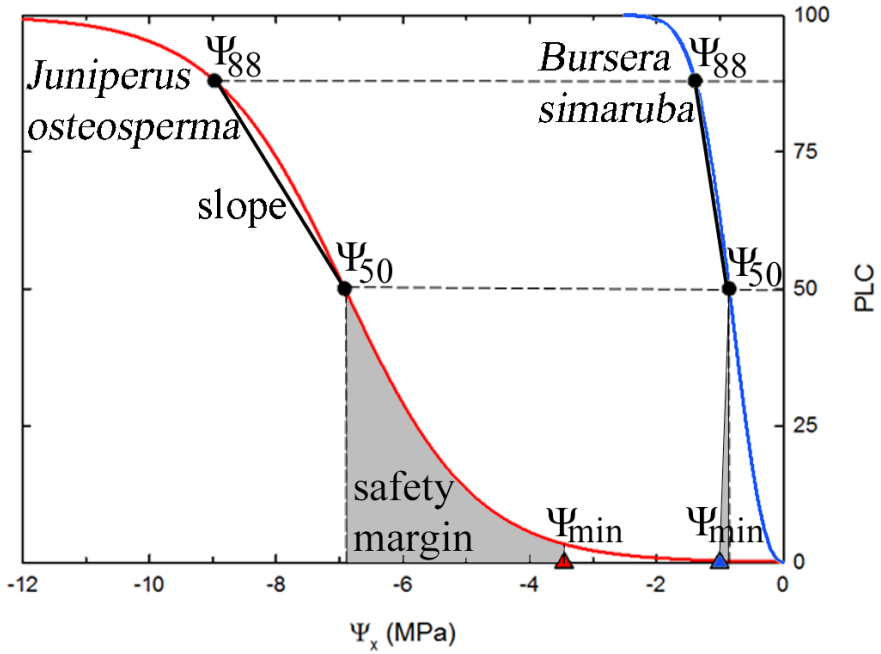
Brendan Choat[1]*, Steven Jansen[2]*, Tim J. Brodribb[3], Hervé Cochard[4,5], Sylvain Delzon[6], Radika Bhaskar[7], Sandra J. Bucci[8], Taylor S. Feild[9], Sean M. Gleason[10], Uwe G. Hacke[11], Anna L. Jacobsen[12], Frederic Lens[13], Hafiz Maherali[14], Jordi Martínez-Vilalta[15,16], Stefan Mayr[17], Maurizio Mencuccini[18,19], Patrick J. Mitchell[20], Andrea Nardini[21], Jarmila Pittermann[22], R. Brandon Pratt[12], John S. Sperry[23], Mark Westoby[10], Ian J. Wright[10] & Amy E. Zanne[24,25]

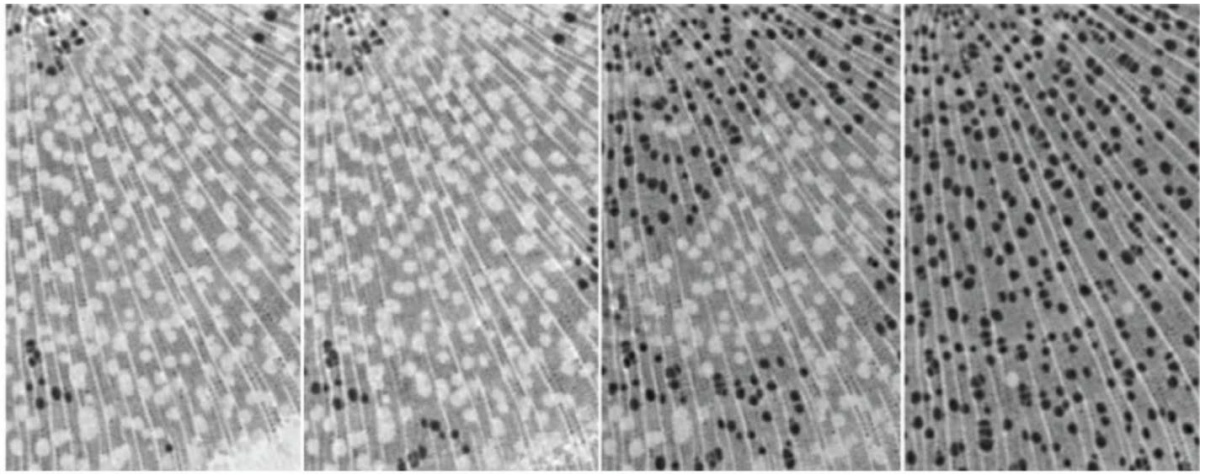
REVIEW

https://doi.org/10.1038/s41586-018-0240-x

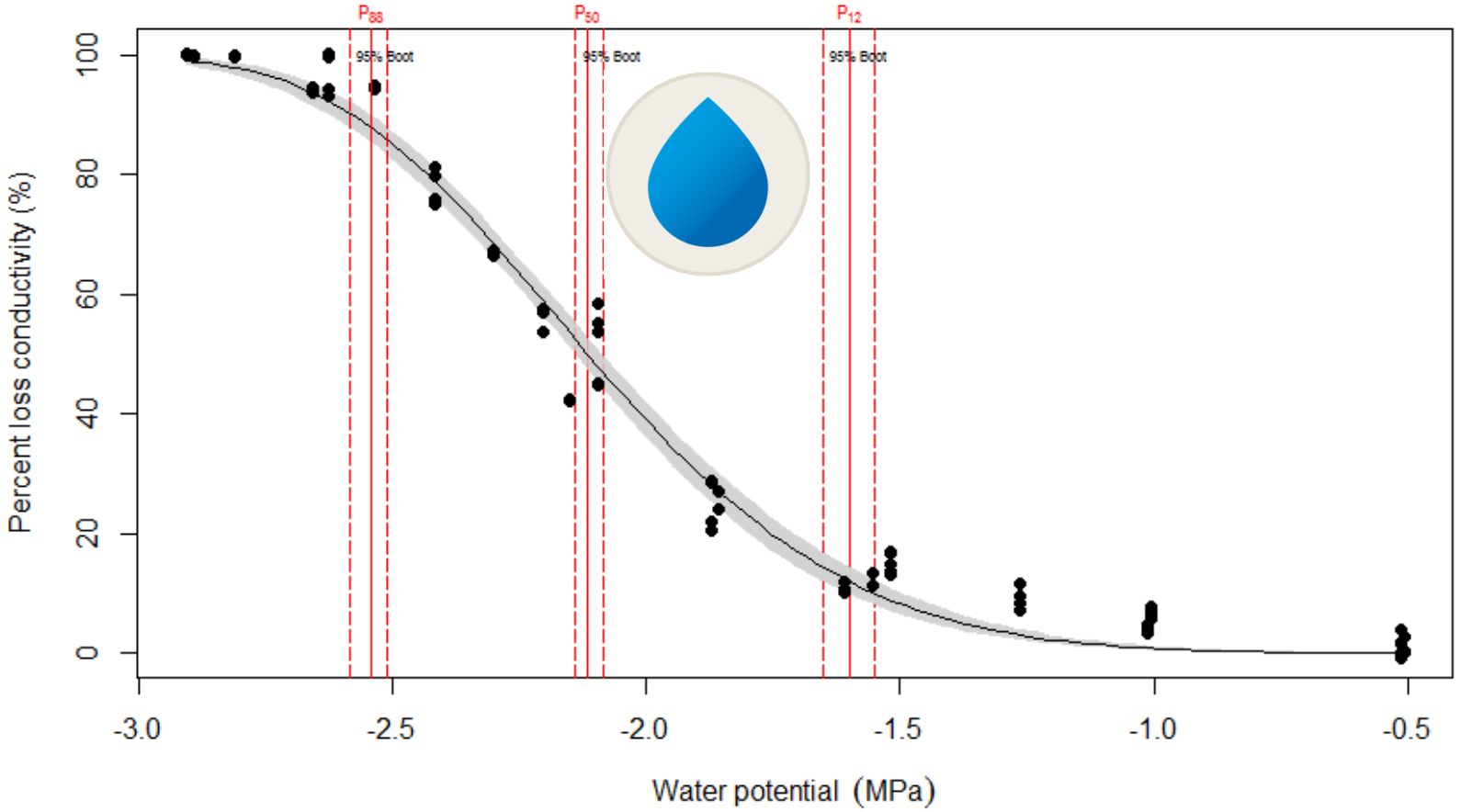
Triggers of tree mortality under drought

Brendan Choat[1]*, Timothy J. Brodribb[2], Craig R. Brodersen[3], Remko A. Duursma[1], Rosana López[1,4] & Belinda E. Medlyn[1]





Vulnerability of amenity trees to embolism





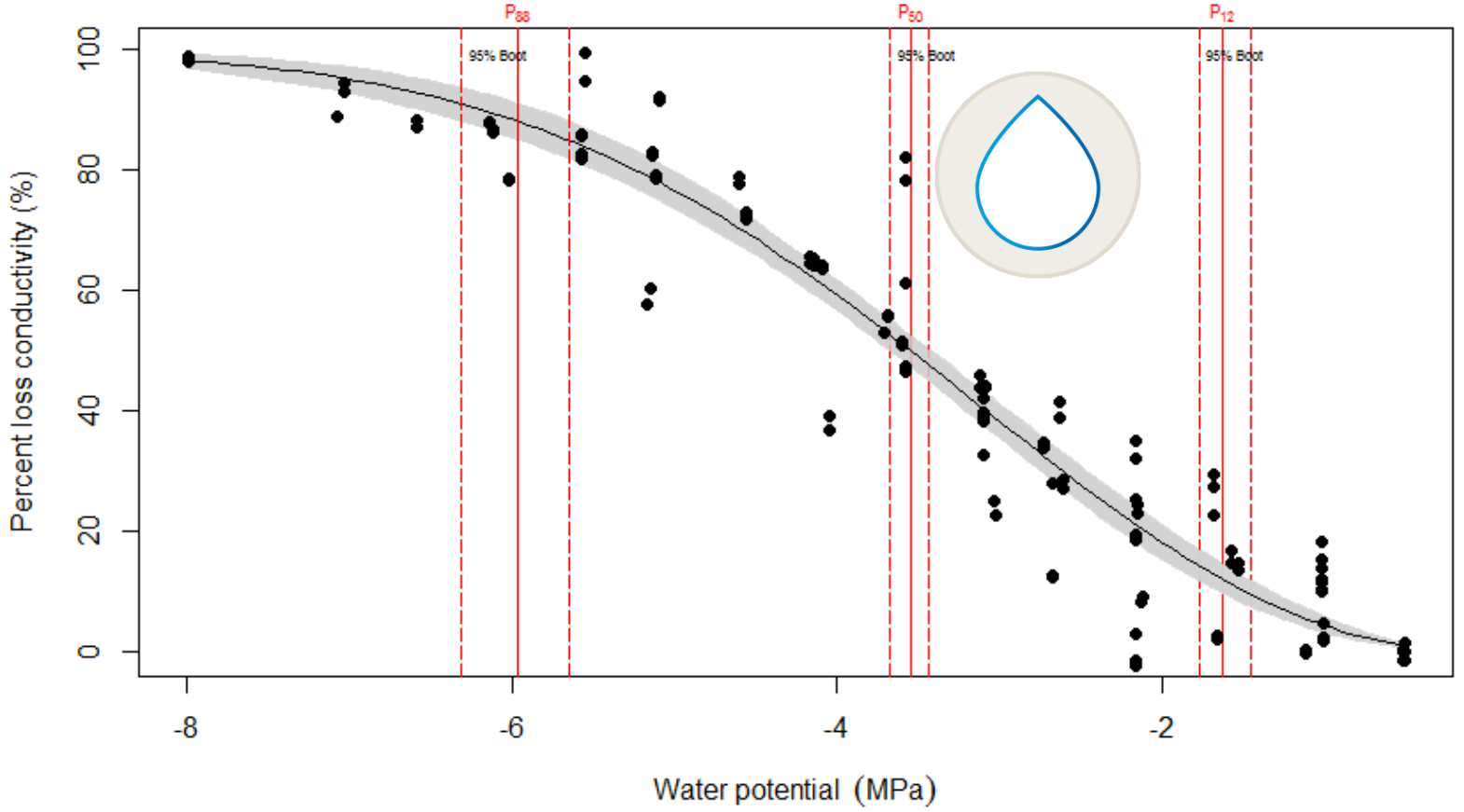
Cercidiphyllum japonicum

TREE FUND
Cultivating Innovation

fund trees

NERC SCIENCE OF THE ENVIRONMENT

Vulnerability of amenity trees to embolism



Eucommia ulmoides



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Consequences of high PLC



Using plant traits – leaf turgor loss

- Leaf turgor loss point can be used as a universal measure of physiological drought tolerance that is quantifiable and measurable

ECOLOGY LETTERS

Ecology Letters, (2012) 15: 393–405 doi: 10.1111/j.1461-0248.2012.01751.x

IDEA AND PERSPECTIVE

The determinants of leaf turgor loss point and prediction of drought tolerance of species and biomes: a global meta-analysis

Megan K. Bartlett, Christine Scoffoni and Lawren Sack*
Department of Ecology and Evolution, University of California Los Angeles, 621 Charles E. Young Drive South, Los Angeles, California 90095, USA

*Correspondence:
E-mail: lawrensack@ucla.edu

Abstract
Increasing drought is one of the most critical challenges facing species and ecosystems worldwide, and improved theory and practices are needed for quantification of species tolerances. Leaf water potential at turgor loss, or wilting (π_{tlp}), is classically recognised as a major physiological determinant of plant water stress response. However, the cellular basis of π_{tlp} and its importance for predicting ecological drought tolerance have been controversial. A meta-analysis of 317 species from 72 studies showed that π_{tlp} was strongly correlated with water availability within and across biomes, indicating power for anticipating drought responses. We derived new equations giving both π_{tlp} and relative water content at turgor loss point (RWC_{tlp}) as explicit functions of osmotic potential at full turgor (π_o) and bulk modulus of elasticity (ε). Sensitivity analyses and meta-analyses showed that π_o is the major driver of π_{tlp}. In contrast, ε plays no direct role in driving drought tolerance within or across species, but sclerophylly and elastic adjustments act to maintain RWC_{tlp}, preventing cell dehydration, and additionally protect against nutrient, mechanical and herbivory stresses independent of drought tolerance. These findings clarify biogeographic trends and the underlying basis of drought tolerance parameters with applications in comparative assessments of species and ecosystems worldwide.

Keywords
Biogeography, biomes, climate, plant hydraulics, plant traits.

Ecology Letters (2012) 15: 393–405



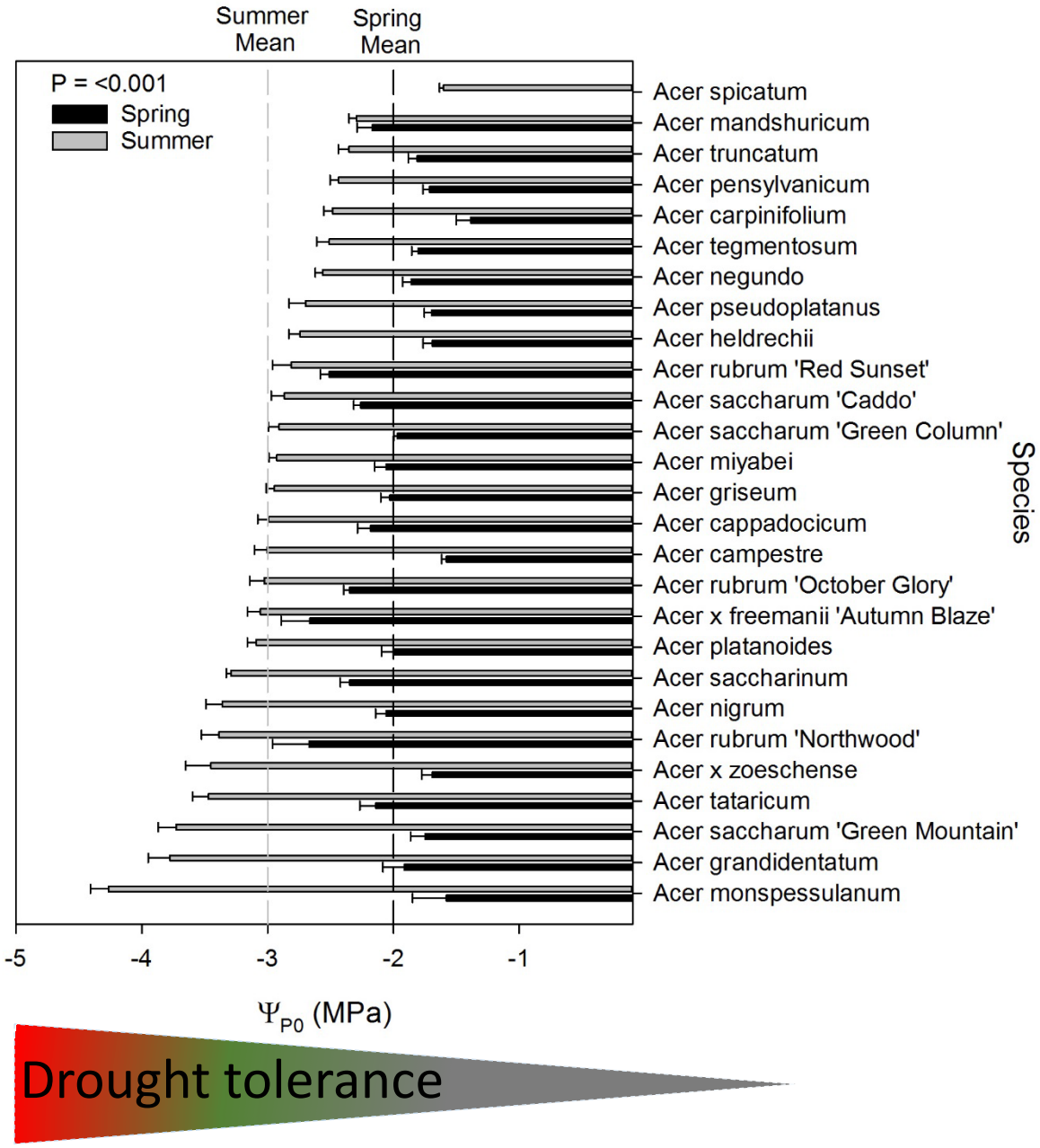
Drought tolerance in *Acer*







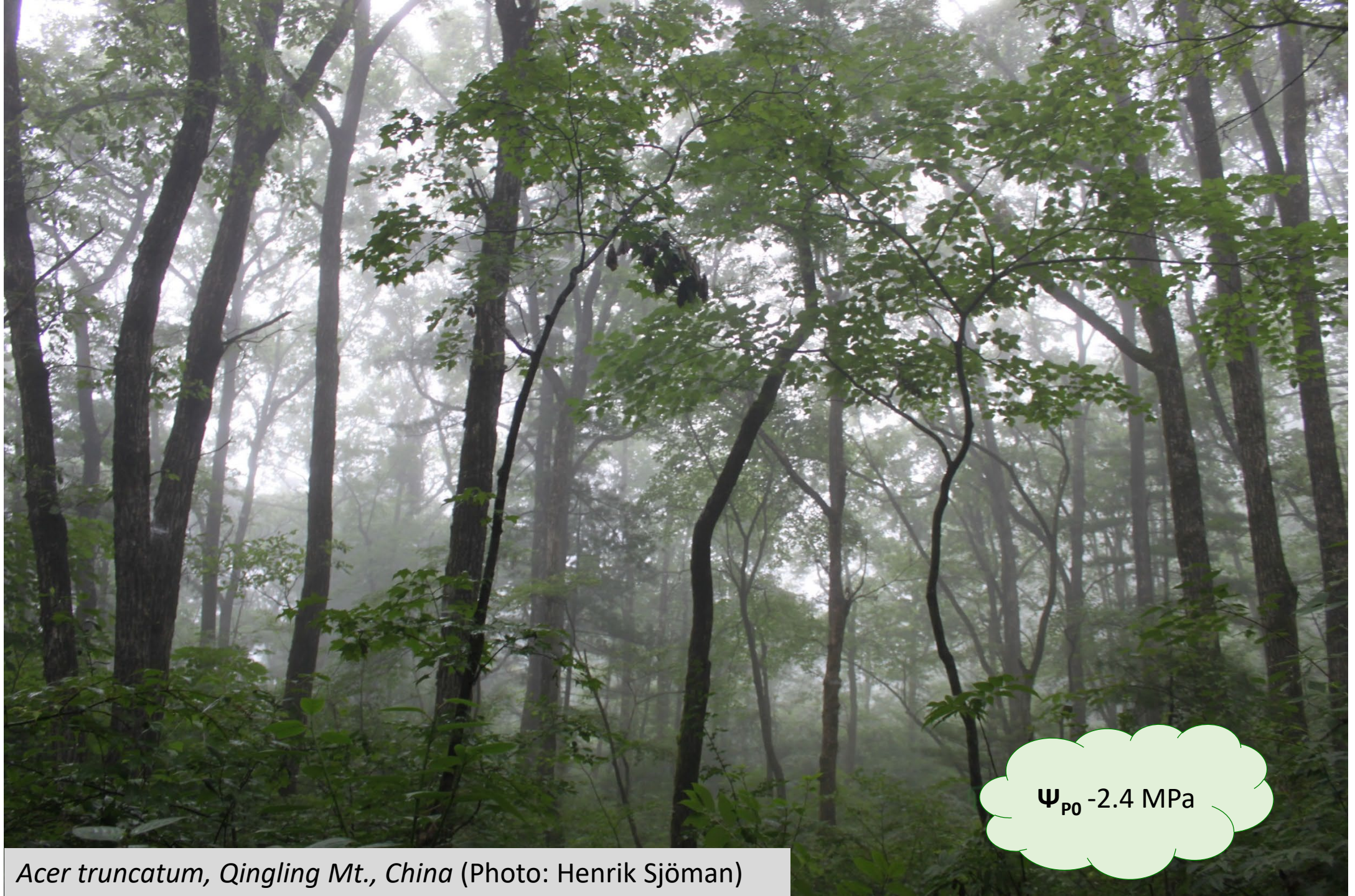




Sjöman, Hirons and Bassuk (2015)



Acer spicatum, NY, USA



Acer truncatum, Qingling Mt., China (Photo: Henrik Sjöman)

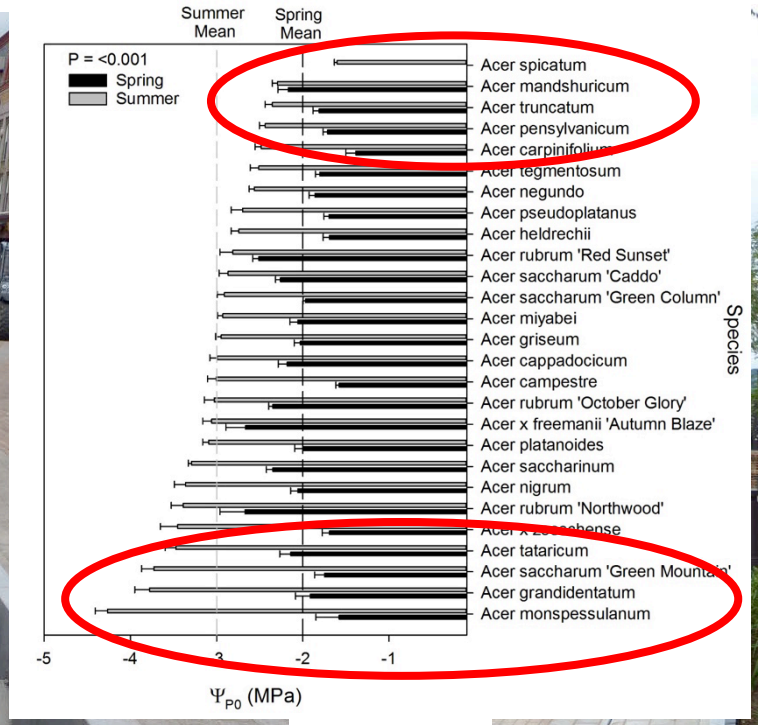


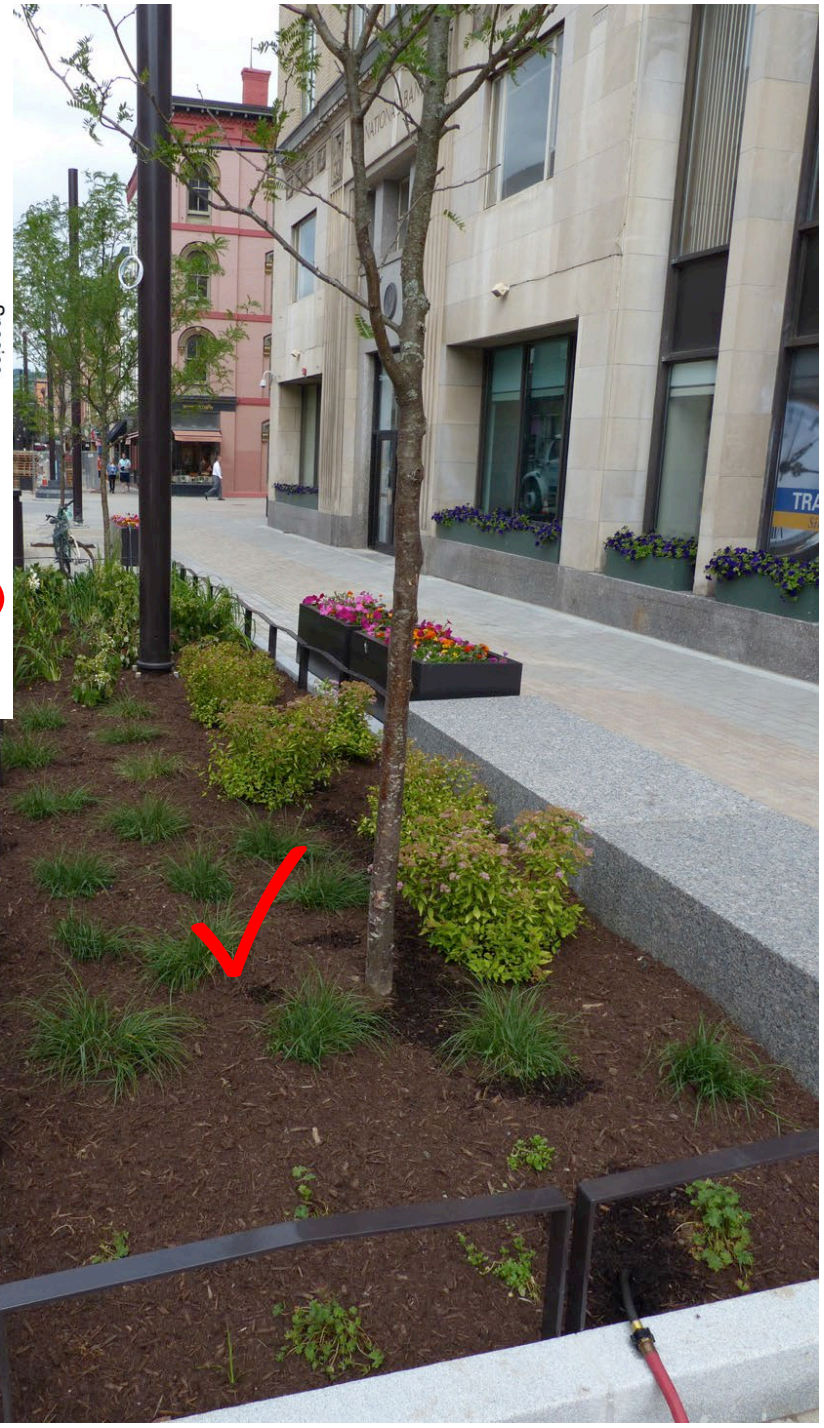
Acer tataricum & Quercus pubescens, Steppe Forest in Eastern Romania. (Photo: Henrik Sjöman)



Acer grandidentatum, Utah, USA (Photo: Henrik Sjöman)

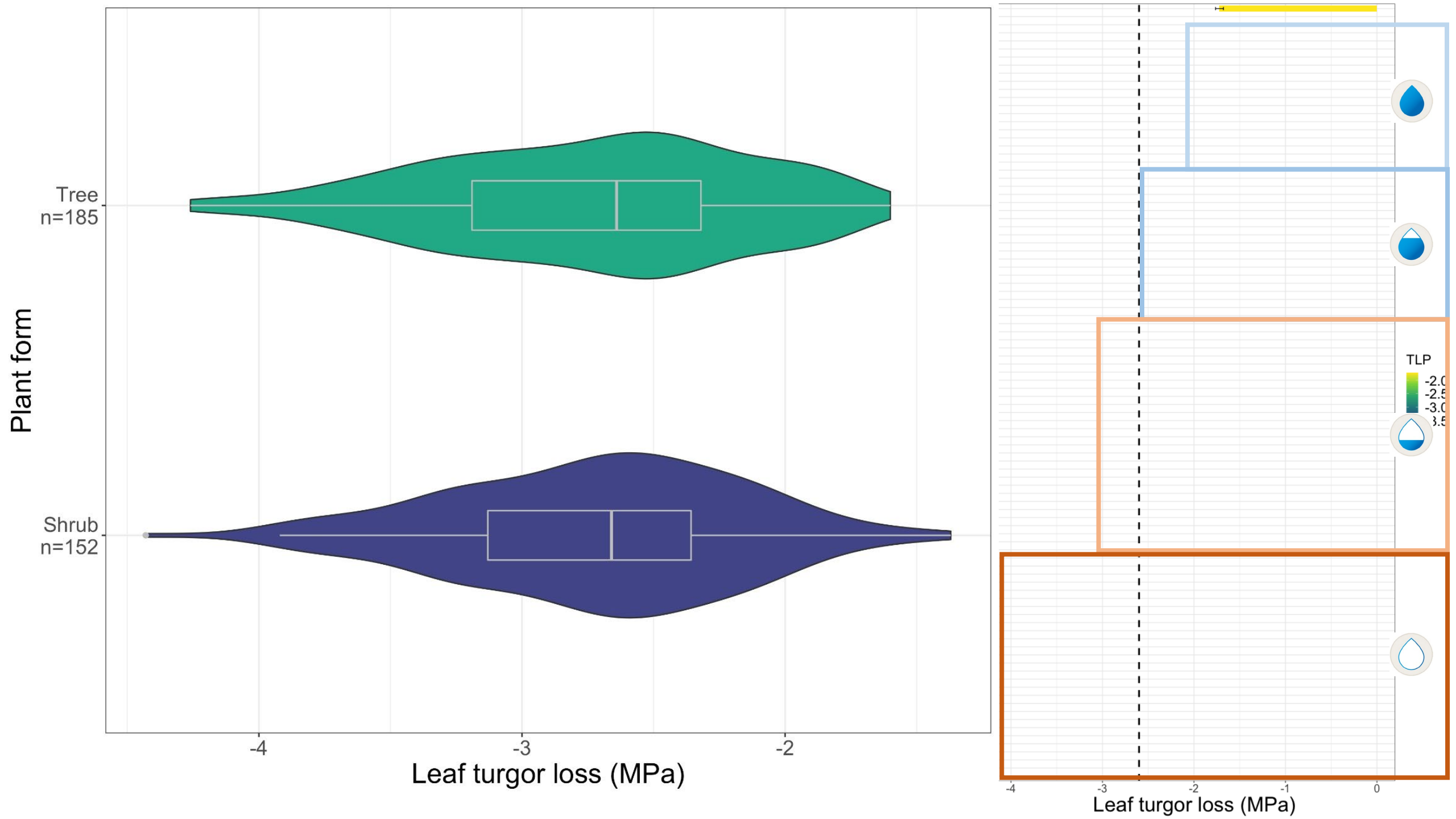




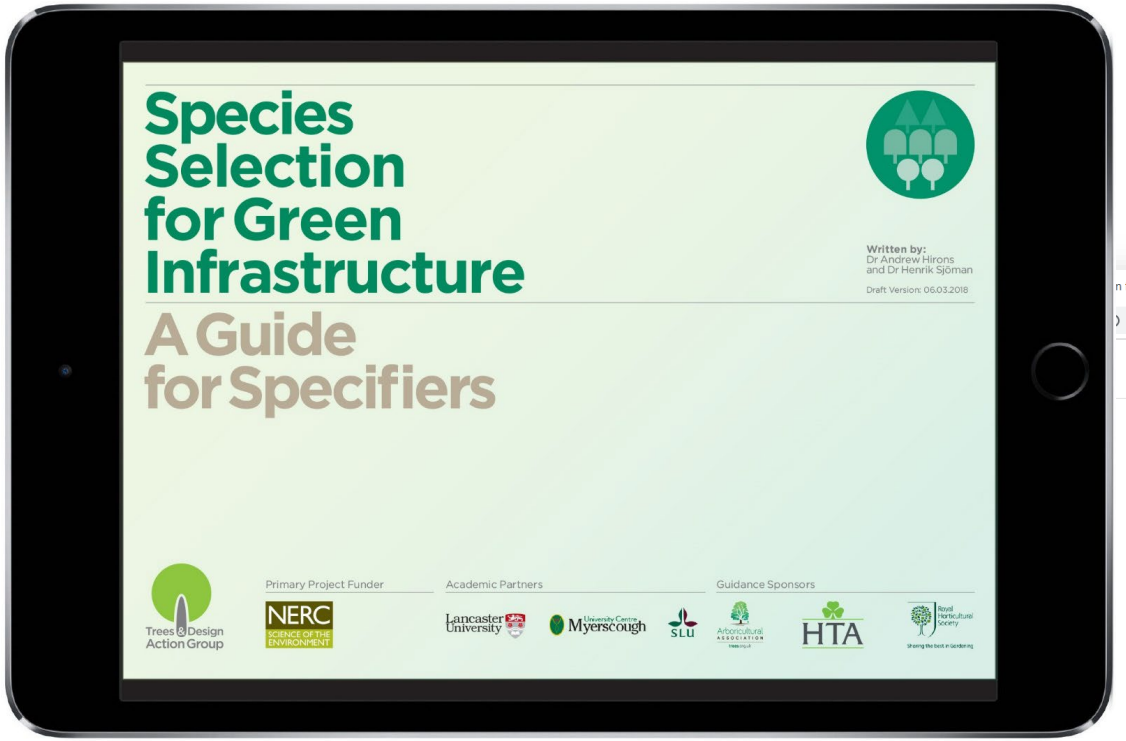


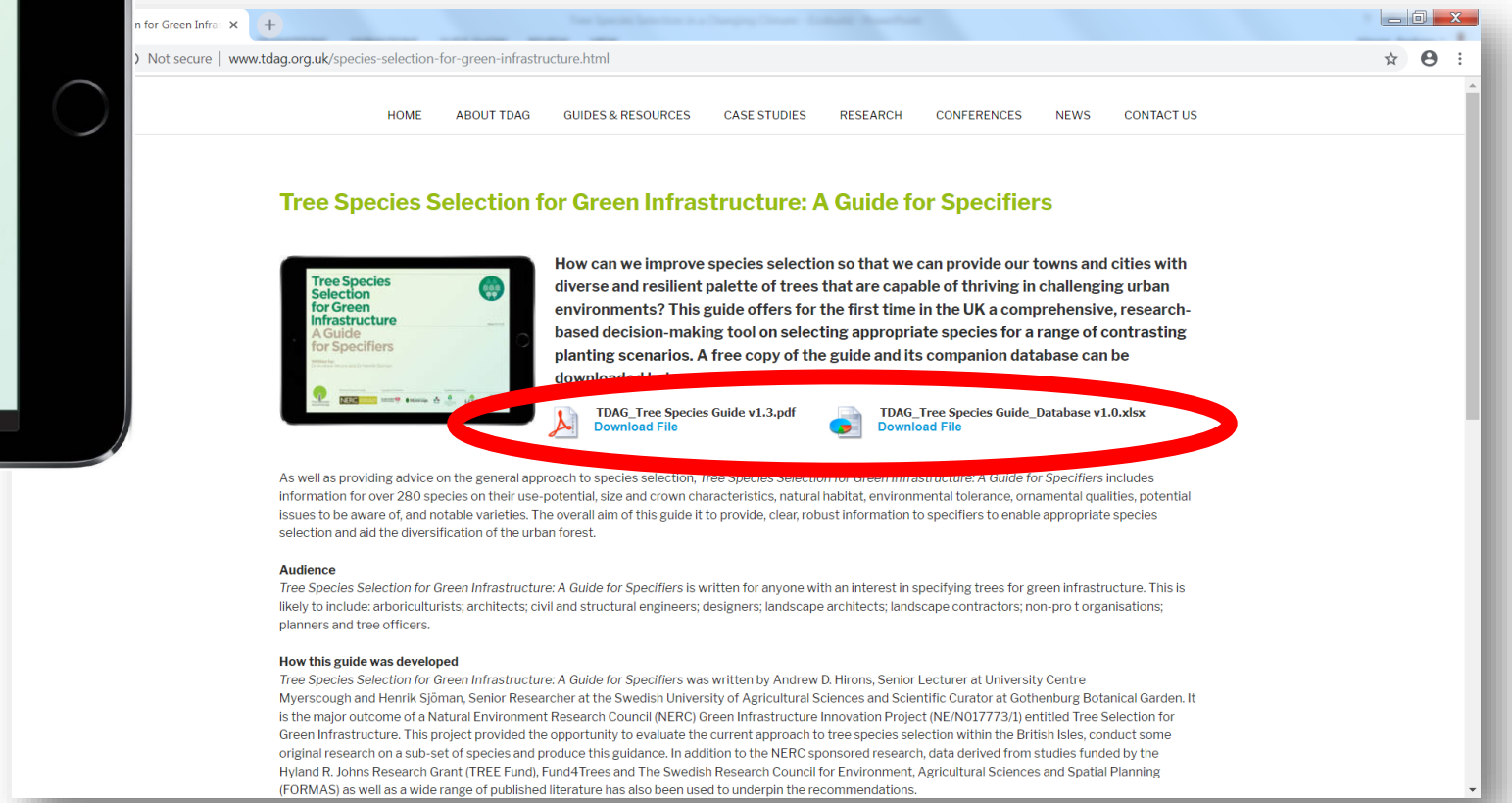


Urban planting beds in Ithaca


Plant form
Tree
n=185
Shrub
n=152
-4
-3
-2
Leaf turgor loss (MPa)
TLP
-2.0
-2.5
-3.0
-4
-3
-2
-1
0
Leaf turgor loss (MPa)

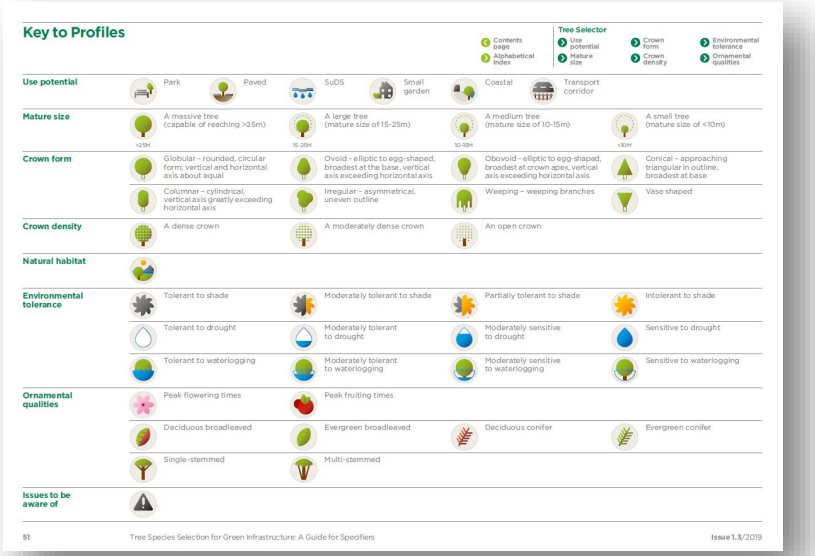
Robust species selection advice is essential





www.tdag.org.uk

The profiles (280+)



Key to Profiles

Contents page · Alphabetical index

Tree Selector: Use potential · Mature size · Crown form · Crown density · Environmental tolerance · Ornamental qualities

Use potential
Park · Paved · SuDS · Small garden · Coastal · Transport corridor

Mature size
A massive tree (capable of reaching >25m) · A large tree (mature size of 15-25m) · A medium tree (mature size of 10-15m) · A small tree (mature size of <10m)

Crown form
Globular – rounded, circular form; vertical and horizontal axis about equal · Ovoid – elliptic to egg-shaped, broadest at the base, vertical axis exceeding horizontal axis · Obovoid – elliptic to egg-shaped, broadest at crown apex, vertical axis exceeding horizontal axis · Conical – approaching triangular in outline, broadest at base
Columnar – cylindrical, vertical axis greatly exceeding horizontal axis · Irregular – asymmetrical, uneven outline · Weeping – weeping branches · Vase shaped

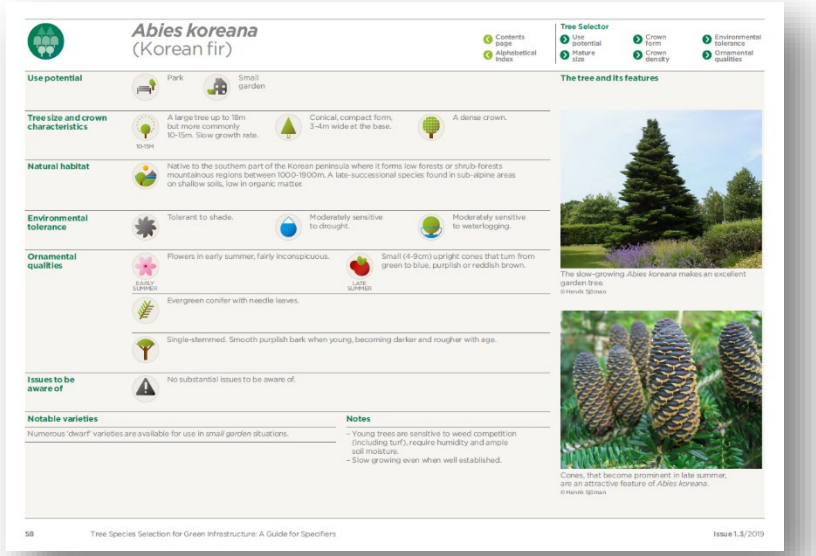
Crown density
A dense crown · A moderately dense crown · An open crown

Natural habitat

Environmental tolerance
Tolerant to shade · Moderately tolerant to shade · Partially tolerant to shade · Intolerant to shade
Tolerant to drought · Moderately tolerant to drought · Moderately sensitive to drought · Sensitive to drought
Tolerant to waterlogging · Moderately tolerant to waterlogging · Moderately sensitive to waterlogging · Sensitive to waterlogging

Ornamental qualities
Peak flowering times · Peak fruiting times
Deciduous broadleaved · Evergreen broadleaved · Deciduous conifer · Evergreen conifer
Single-stemmed · Multi-stemmed

Issues to be aware of



Abies koreana (Korean fir)

Contents page · Alphabetical index

Tree Selector: Use potential · Mature size · Crown form · Crown density · Environmental tolerance · Ornamental qualities

Use potential
Park · Small garden

Tree size and crown characteristics
A large tree up to 18m but more commonly 10-15m. Slow growth rate. · Conical, compact form, 3-4m wide at the base. · A dense crown.

Natural habitat
Native to the southern part of the Korean peninsula where it forms low forests or shrub-forests mountainous regions between 1000-1900m. A late-successional species found in sub-alpine areas on shallow soils, low in organic matter.

Environmental tolerance
Tolerant to shade. · Moderately sensitive to drought. · Moderately sensitive to waterlogging.

Ornamental qualities
Flowers in early summer, fairly inconspicuous. · Small (4-8cm) upright cones that turn from green to blue, purplish or reddish brown.
Evergreen conifer with needle leaves.
Single-stemmed. Smooth purplish bark when young, becoming darker and rougher with age.

Issues to be aware of
No substantial issues to be aware of.

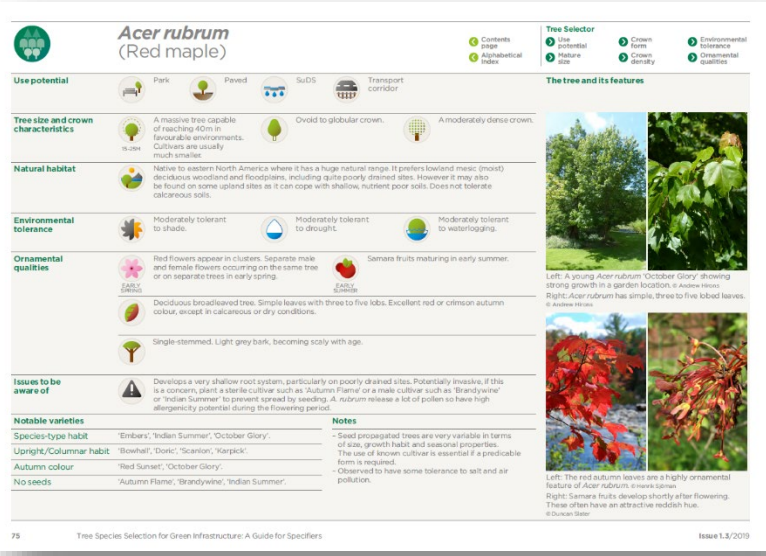
Notable varieties
Numerous 'dwarf' varieties are available for use in *small garden* situations.

Notes
- Young trees are sensitive to weed competition (including turf), require humidity and ample soil moisture.
- Slow growing even when well established.

The tree and its features

The slow-growing *Abies koreana* makes an excellent garden tree. © Henrik Sjöman

Cones, that become prominent in late summer, are an attractive feature of *Abies koreana*. © Henrik Sjöman



Acer rubrum (Red maple)

Contents page · Alphabetical index

Tree Selector: Use potential · Mature size · Crown form · Crown density · Environmental tolerance · Ornamental qualities

Use potential
Park · Paved · SuDS · Transport corridor

Tree size and crown characteristics
A massive tree capable of reaching 40m in favourable environments. Cultivars are usually much smaller. · Ovoid to globular crown. · A moderately dense crown.

Natural habitat
Native to eastern North America where it has a huge natural range. It prefers lowland mesic (moist) deciduous woodland and floodplains, including quite poorly drained sites. However it may also be found on some upland sites as it can cope with shallow, nutrient poor soils. Does not tolerate calcareous soils.

Environmental tolerance
Moderately tolerant to shade. · Moderately tolerant to drought. · Moderately tolerant to waterlogging.

Ornamental qualities
Red flowers appear in clusters. Separate male and female flowers occurring on the same tree or on separate trees in early spring. · Samara fruits maturing in early summer.
Deciduous broadleaved tree. Simple leaves with three to five lobs. Excellent red or crimson autumn colour, except in calcareous or dry conditions.
Single-stemmed. Light grey bark, becoming scaly with age.

Issues to be aware of
Develops a very shallow root system, particularly on poorly drained sites. Potentially invasive, if this is a concern, plant a sterile cultivar such as 'Autumn Flame' or a male cultivar such as 'Brandywine' or 'Indian Summer' to prevent spread by seeding. *A. rubrum* release a lot of pollen so have high allergenicity potential during the flowering period.

Notable varieties

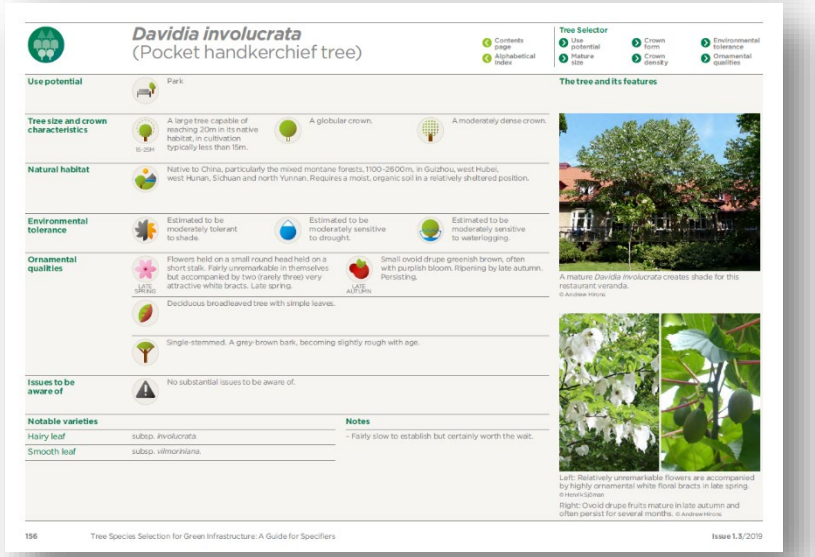
Species-type habit	'Embers', 'Indian Summer', 'October Glory'.
Upright/Columnar habit	'Bowhall', 'Doric', 'Scanlon', 'Karpick'.
Autumn colour	'Red Sunset', 'October Glory'.
No seeds	'Autumn Flame', 'Brandywine', 'Indian Summer'.

Notes
- Seed propagated trees are very variable in terms of size, growth habit and seasonal properties. The use of known cultivar is essential if a predicable form is required.
- Observed to have some tolerance to salt and air pollution.

The tree and its features

Left: A young *Acer rubrum* 'October Glory' showing strong growth in a garden location. © Andrew Hirons
Right: *Acer rubrum* has simple, three to five lobed leaves. © Andrew Hirons

Left: The red autumn leaves are a highly ornamental feature of *Acer rubrum*. © Henrik Sjöman
Right: Samara fruits develop shortly after flowering. These often have an attractive reddish hue. © Duncan Slater



Davidia involucrata (Pocket handkerchief tree)

Contents page · Alphabetical index

Tree Selector: Use potential · Mature size · Crown form · Crown density · Environmental tolerance · Ornamental qualities

Use potential
Park

Tree size and crown characteristics
A large tree capable of reaching 20m in its native habitat, in cultivation typically less than 15m. · A globular crown. · A moderately dense crown.

Natural habitat
Native to China, particularly the mixed montane forests, 1100-2600m, in Guizhou, west Hubei, west Hunan, Sichuan and north Yunnan. Requires a moist, organic soil in a relatively sheltered position.

Environmental tolerance
Estimated to be moderately tolerant to shade. · Estimated to be moderately sensitive to drought. · Estimated to be moderately sensitive to waterlogging.

Ornamental qualities
Flowers held on a small round head held on a short stalk. Fairly unremarkable in themselves but accompanied by two (rarely three) very attractive white bracts. Late spring. · Small ovoid drupe greenish brown, often with purplish bloom. Ripening by late autumn. Persisting.
Deciduous broadleaved tree with simple leaves.
Single-stemmed. A grey-brown bark, becoming slightly rough with age.

Issues to be aware of
No substantial issues to be aware of.

Notable varieties

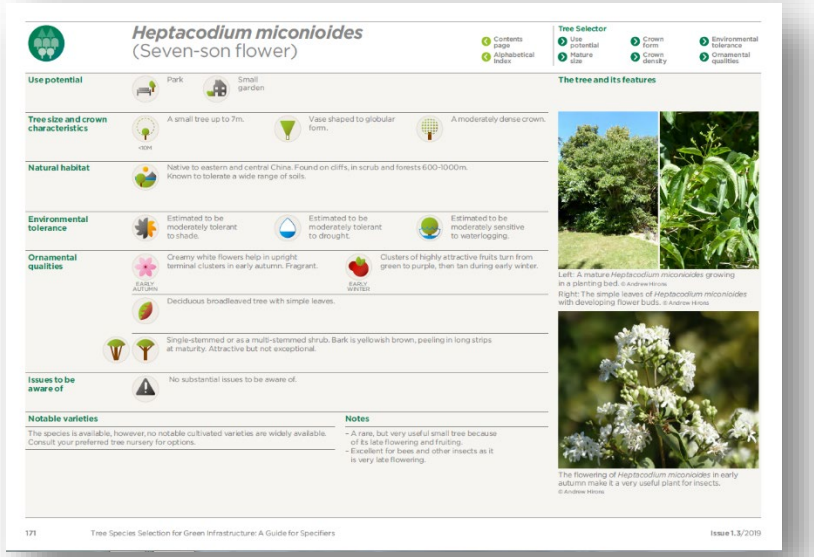
Hairy leaf	subsp. *involucrata*.
Smooth leaf	subsp. *vilmoriniana*.

Notes
- Fairly slow to establish but certainly worth the wait.

The tree and its features

A mature *Davidia involucrata* creates shade for this restaurant veranda. © Andrew Hirons

Left: Relatively unremarkable flowers are accompanied by highly ornamental white floral bracts in late spring. © Henrik Sjöman
Right: Ovoid drupe fruits mature in late autumn and often persist for several months. © Andrew Hirons



Heptacodium miconioides (Seven-son flower)

Contents page · Alphabetical index

Tree Selector: Use potential · Mature size · Crown form · Crown density · Environmental tolerance · Ornamental qualities

Use potential
Park · Small garden

Tree size and crown characteristics
A small tree up to 7m. · Vase shaped to globular form. · A moderately dense crown.

Natural habitat
Native to eastern and central China. Found on cliffs, in scrub and forests 600-1000m. Known to tolerate a wide range of soils.

Environmental tolerance
Estimated to be moderately tolerant to shade. · Estimated to be moderately tolerant to drought. · Estimated to be moderately sensitive to waterlogging.

Ornamental qualities
Creamy white flowers help in upright terminal clusters in early autumn. Fragrant. · Clusters of highly attractive fruits turn from green to purple, then tan during early winter.
Deciduous broadleaved tree with simple leaves.
Single-stemmed or as a multi-stemmed shrub. Bark is yellowish brown, peeling in long strips at maturity. Attractive but not exceptional.

Issues to be aware of
No substantial issues to be aware of.

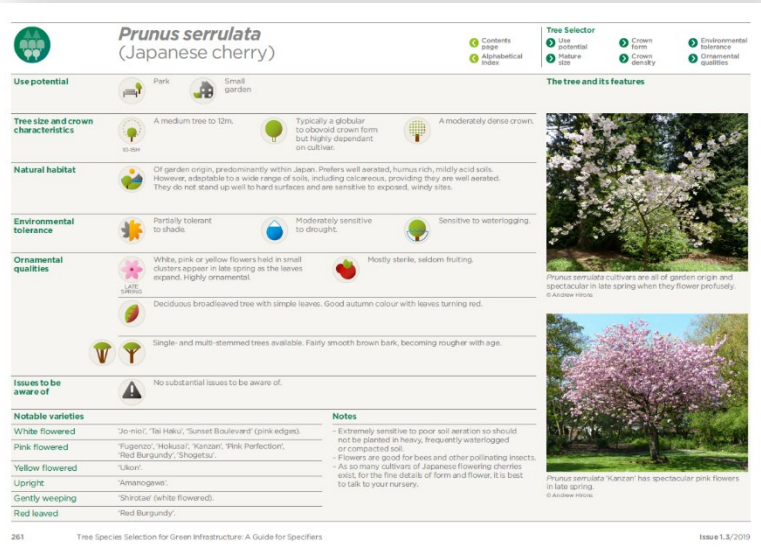
Notable varieties
The species is available, however, no notable cultivated varieties are widely available. Consult your preferred tree nursery for options.

Notes
- A rare, but very useful small tree because of its late flowering and fruiting.
- Excellent for bees and other insects as it is very late flowering.

The tree and its features

Left: A mature *Heptacodium miconioides* growing in a planting bed. © Andrew Hirons
Right: The simple leaves of *Heptacodium miconioides* with developing flower buds. © Andrew Hirons

The flowering of *Heptacodium miconioides* in early autumn make it a very useful plant for insects. © Andrew Hirons



Prunus serrulata (Japanese cherry)

Contents page · Alphabetical index

Tree Selector: Use potential · Mature size · Crown form · Crown density · Environmental tolerance · Ornamental qualities

Use potential
Park · Small garden

Tree size and crown characteristics
A medium tree to 12m. · Typically a globular to obovoid crown form but highly dependant on cultivar. · A moderately dense crown.

Natural habitat
Of garden origin, predominantly within Japan. Prefers well aerated, humus rich, mildly acid soils. However, adaptable to a wide range of soils, including calcareous, providing they are well aerated. They do not stand up well to hard surfaces and are sensitive to exposed, windy sites.

Environmental tolerance
Partially tolerant to shade. · Moderately sensitive to drought. · Sensitive to waterlogging.

Ornamental qualities
White, pink or yellow flowers held in small clusters appear in late spring as the leaves expand. Highly ornamental. · Mostly sterile, seldom fruiting.
Deciduous broadleaved tree with simple leaves. Good autumn colour with leaves turning red.
Single- and multi-stemmed trees available. Fairly smooth brown bark, becoming rougher with age.

Issues to be aware of
No substantial issues to be aware of.

Notable varieties

White flowered	'Jo-nioi', 'Tai Haku', 'Sunset Boulevard' (pink edges).
Pink flowered	'Fugenzo', 'Hokusai', 'Kanzan', 'Pink Perfection', 'Red Burgundy', 'Shogetsu'.
Yellow flowered	'Ukon'.
Upright	'Amanogawa'.
Gently weeping	'Shirotae' (white flowered).
Red leaved	'Red Burgundy'.

Notes
- Extremely sensitive to poor soil aeration so should not be planted in heavy, frequently waterlogged or compacted soil.
- Flowers are good for bees and other pollinating insects.
- As so many cultivars of Japanese flowering cherries exist, for the fine details of form and flowar, it is best to talk to your nursery.

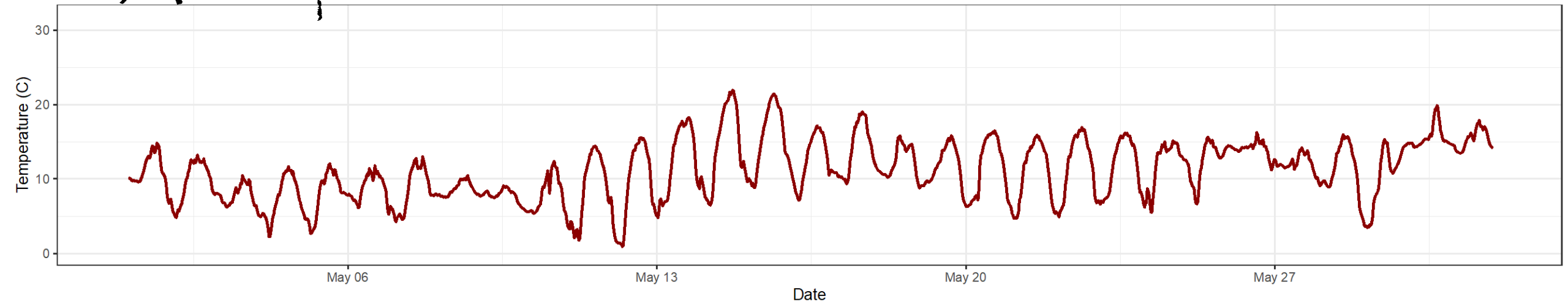
The tree and its features

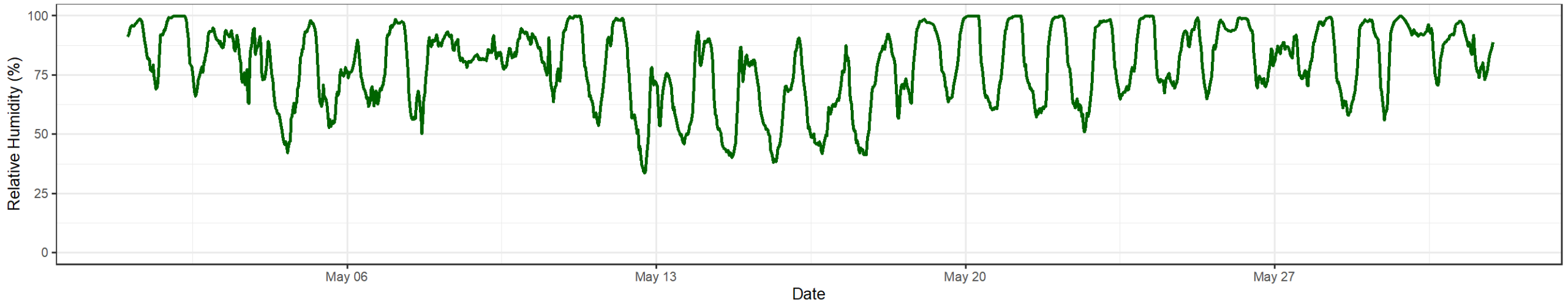
Prunus serrulata cultivars are all of garden origin and spectacular in late spring when they flower profusely. © Andrew Hirons

Prunus serrulata 'Kanzan' has spectacular pink flowers in late spring. © Andrew Hirons


How much water do landscape trees use?

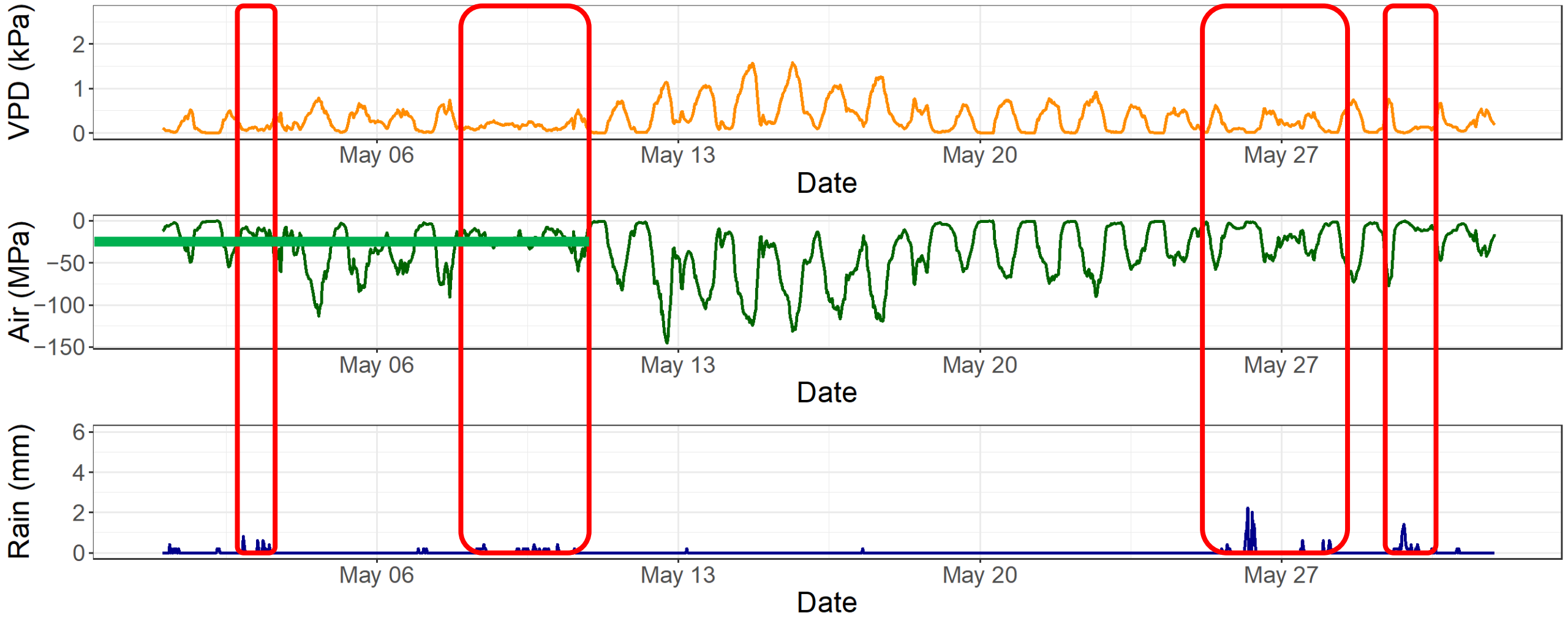
Atmospheric demand for water





Data from Myerscough College, Preston, Lancashire

VPD and Water Potential of the Air

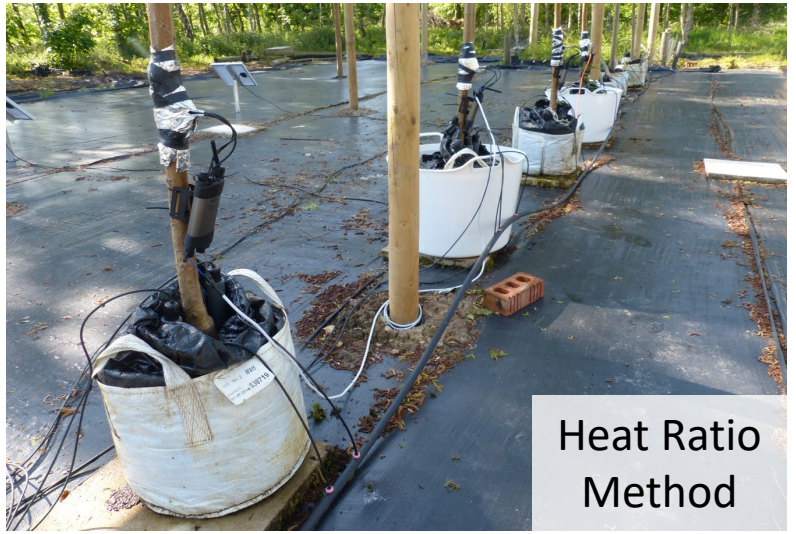


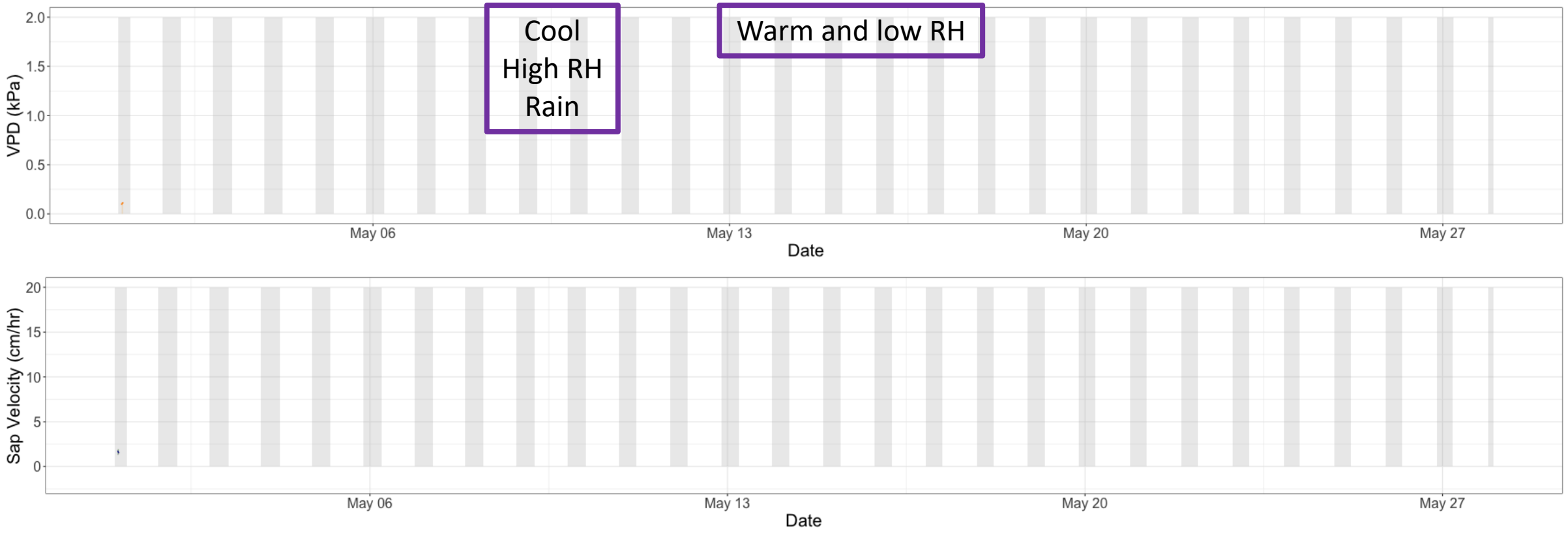
N.B. The water potential of the air shown here assumes the molal volume of water at 20°C so does have a slight source of error as the temperature clearly varies. The error is relatively small though.

Data from Myerscough College, Preston, Lancashire

Sap flow in *Prunus maackii* trees

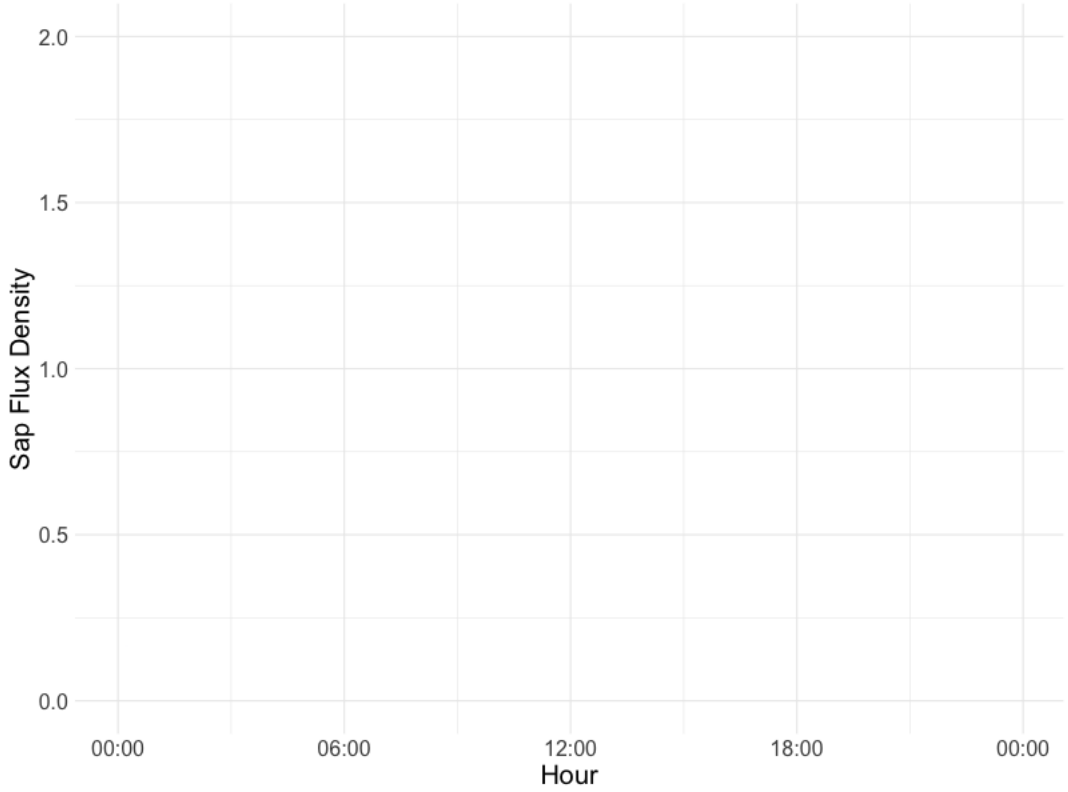
i) Continuous data
ii) Sensitive to atmospheric and edaphic conditions
iii) Integrates the root system and the crown
iv) Can determine sap flow dynamics and volume of water transpired





Ulmus 'New Horizon' - Warm Day

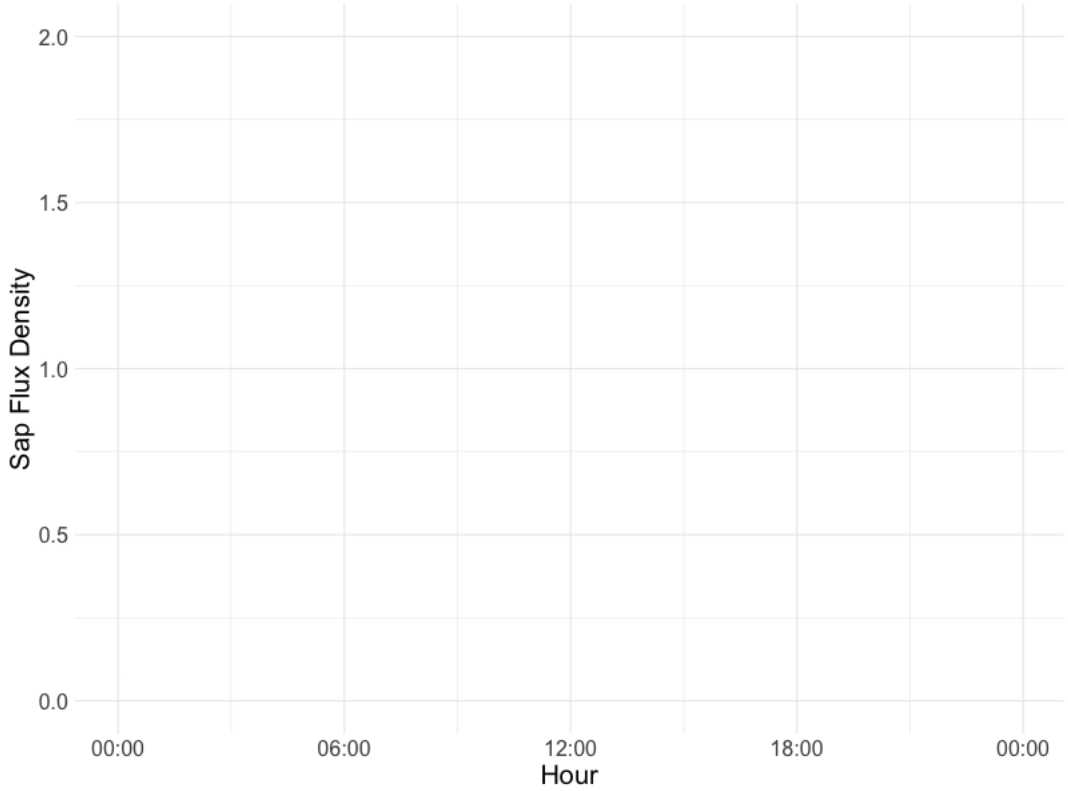




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Ulmus 'New Horizon' - Wet Day

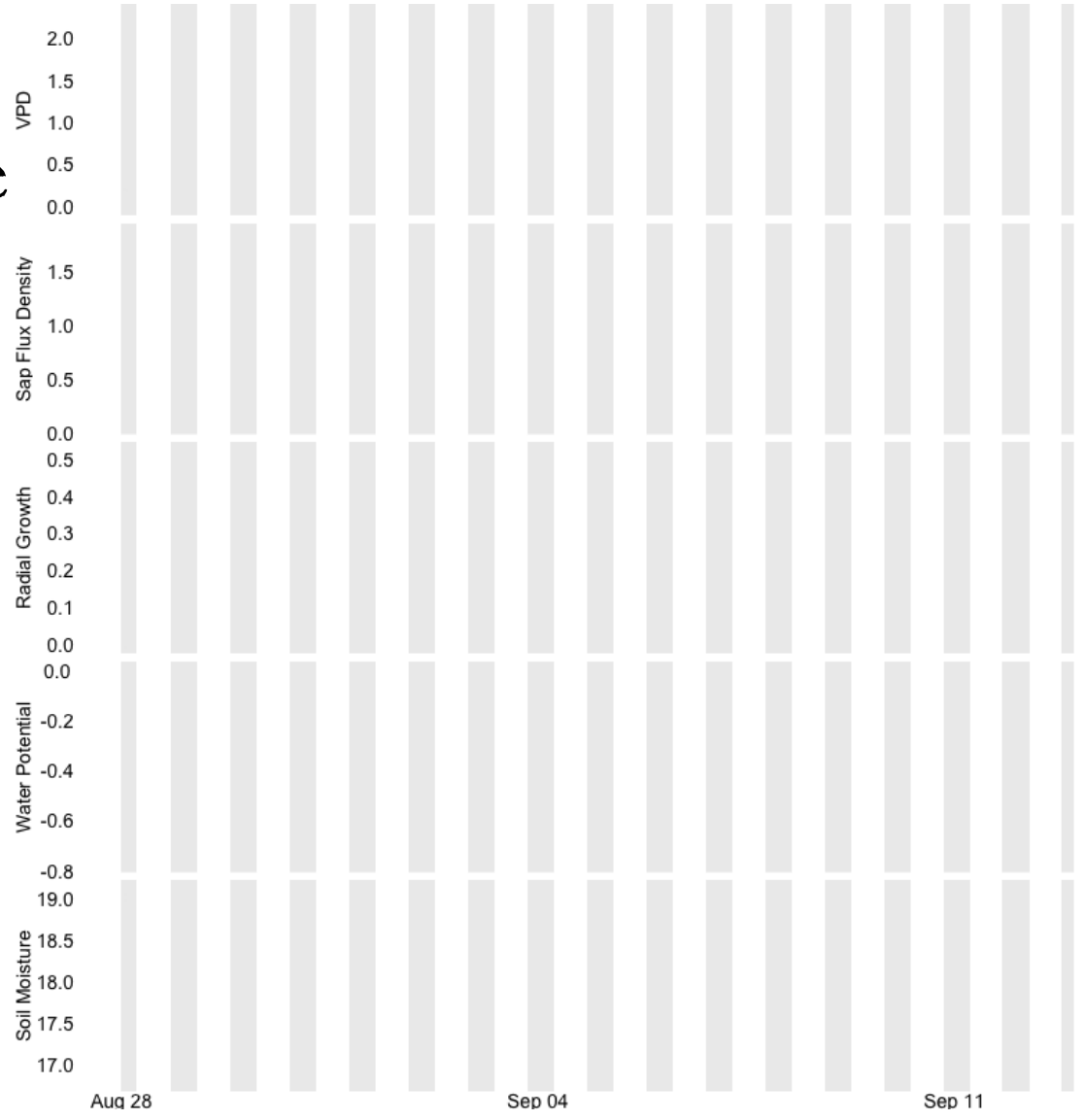




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Ulmus 'New Horizon' - Heatwave

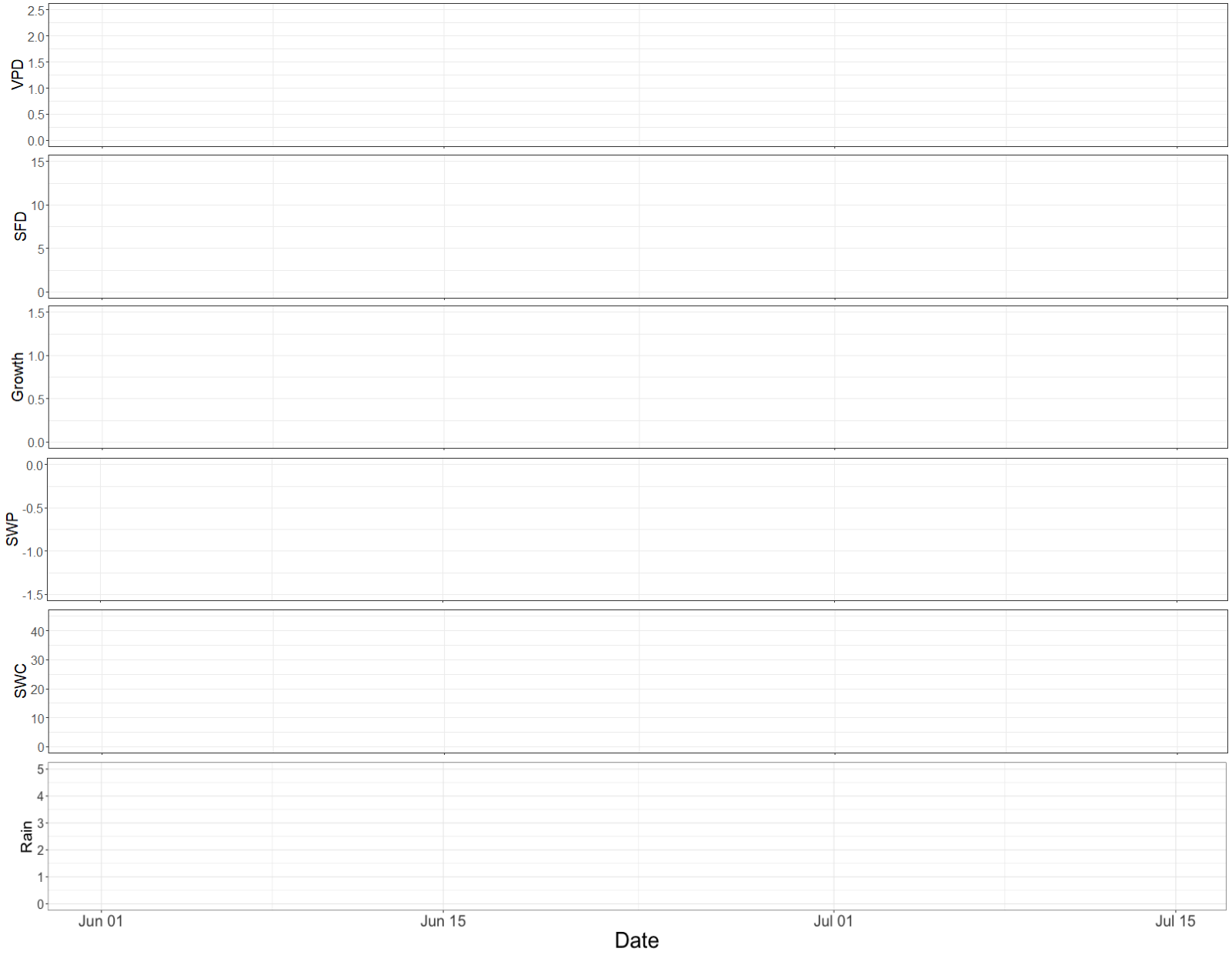




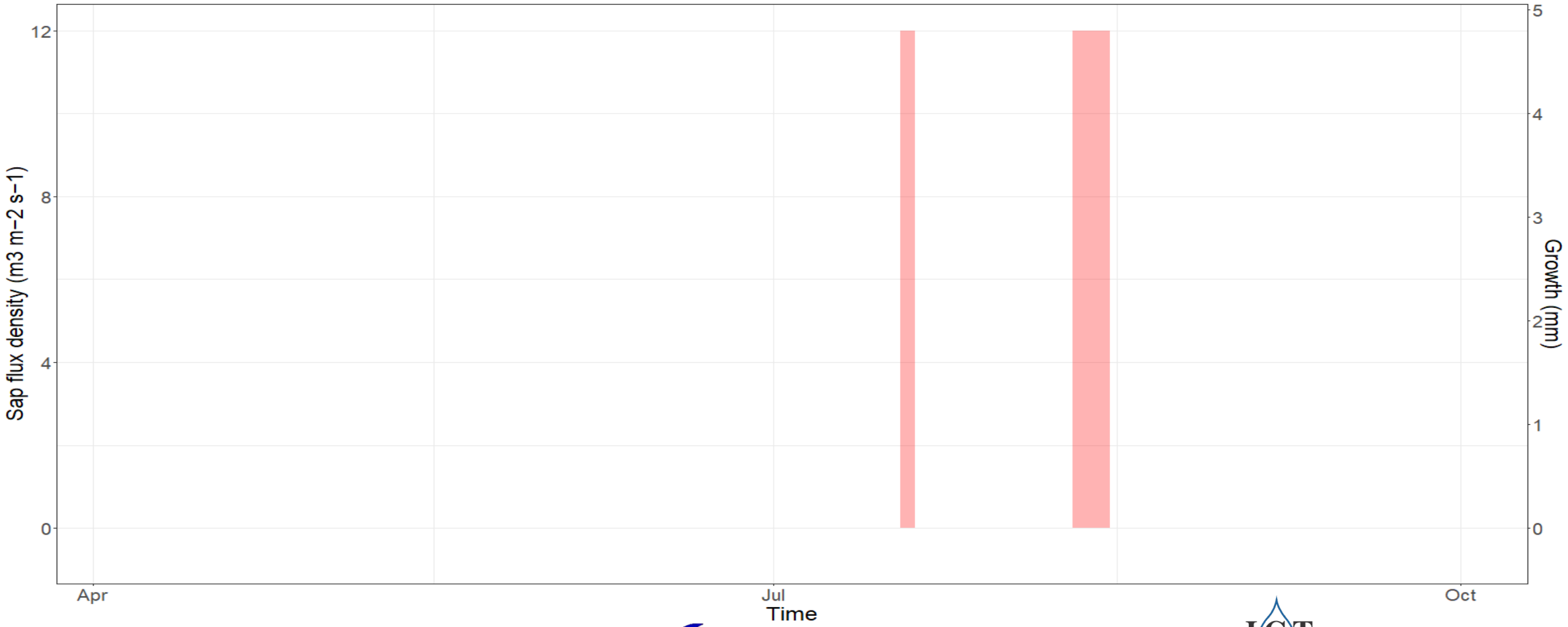
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Tilia cordata
Response to soil drying

- In late June a period of warm, dry weather and increasing vapour pressure deficit (VPD) leads to soil drying. This can be seen via the soil water potential (SWP) and the soil water content (SWC).
- This *Tilia cordata* tree responds by reducing sap flux density (SFD).
- The increasing water stress is also expressed with an increasing maximum daily shrinkage (Growth).
- Stress is alleviated by rainfall in late June-early July (Rain).



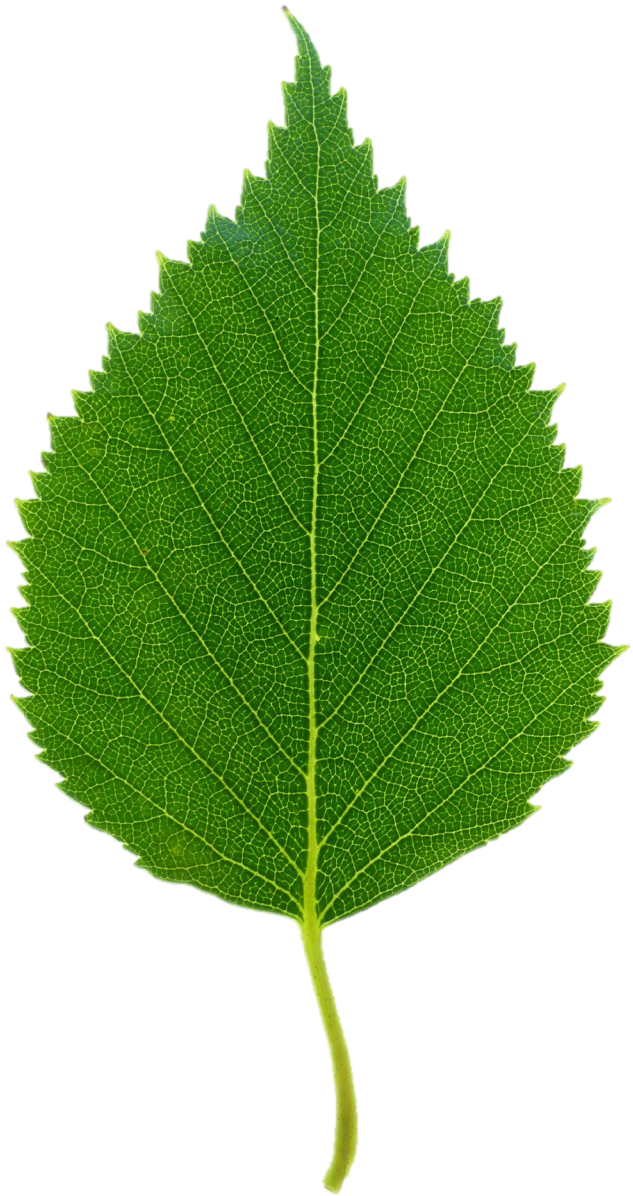
Pyrus calleryana - Sap flow vs. growth



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Taxonomic review

Methodological Approach



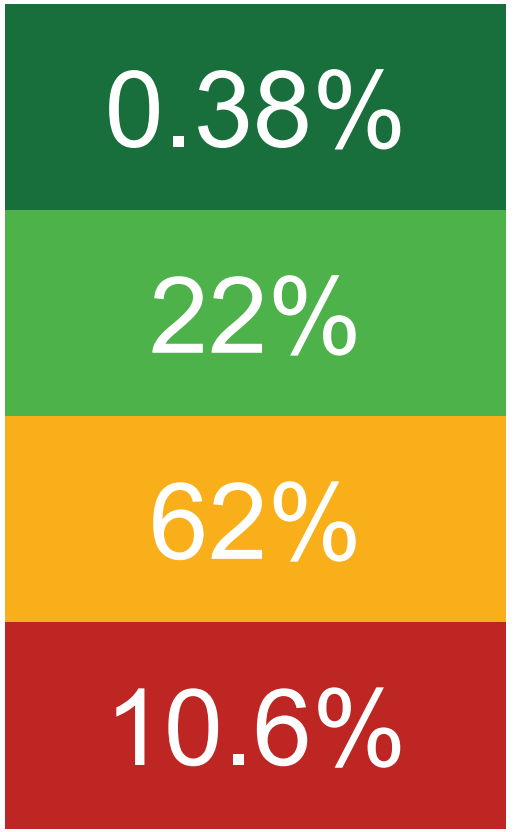
Species distribution modelling

Trait analysis

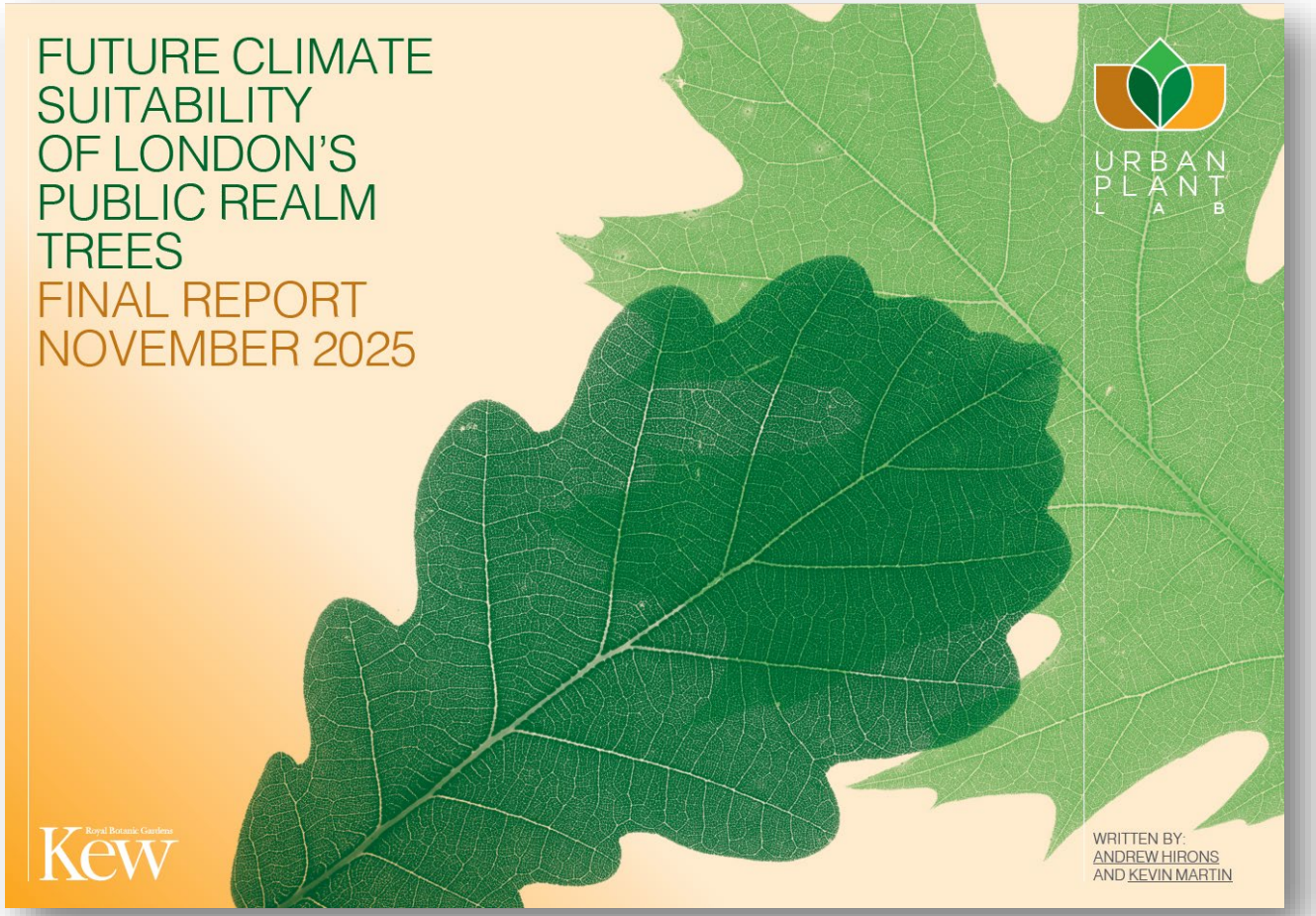


CLUSTER SCORE 4 3 2 1

Outcomes

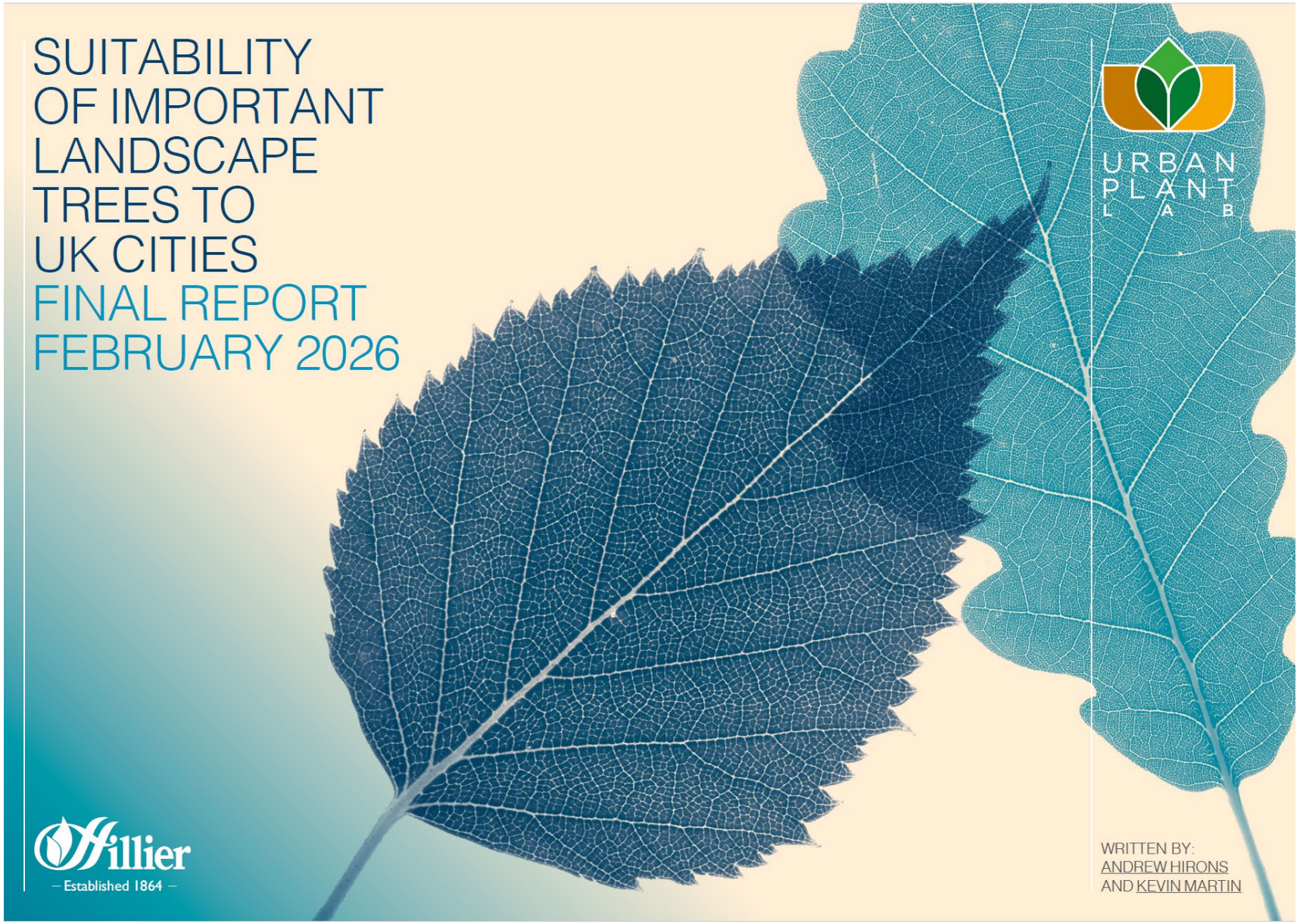


Download the report



The Urban Plant Lab report on the *Future Climate Suitability of London's Public Realm Trees* is now out!

https://www.london.gov.uk/media/110943/download

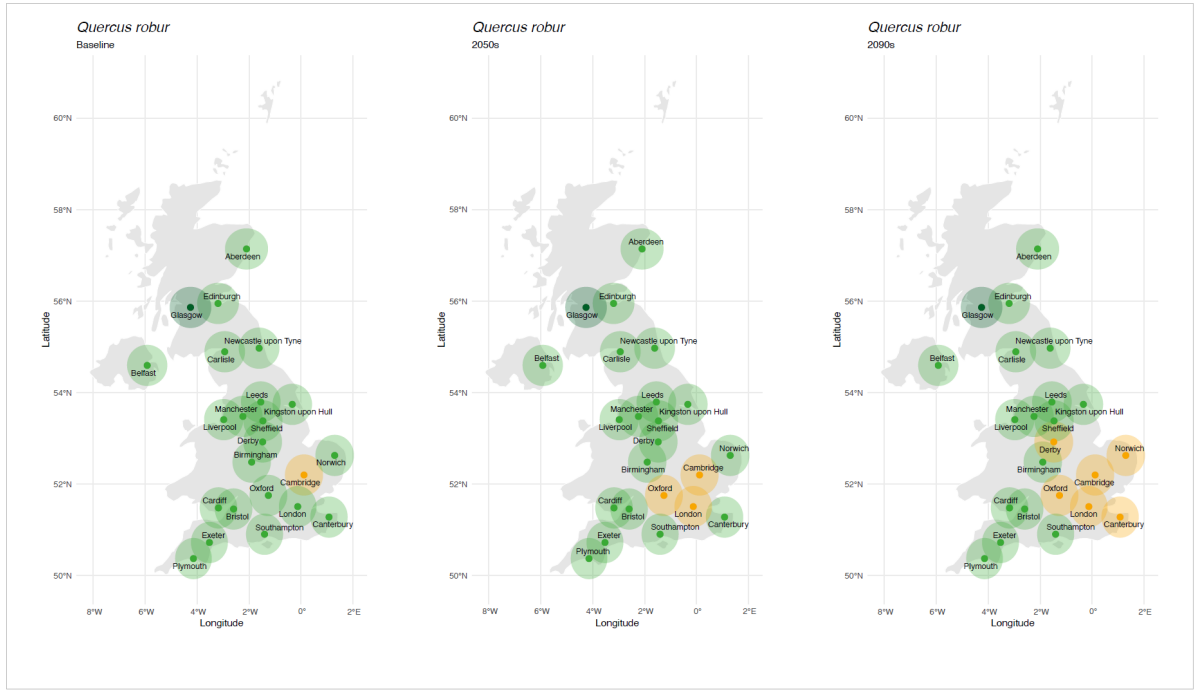


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Pedunculate oak – *Quercus robur*



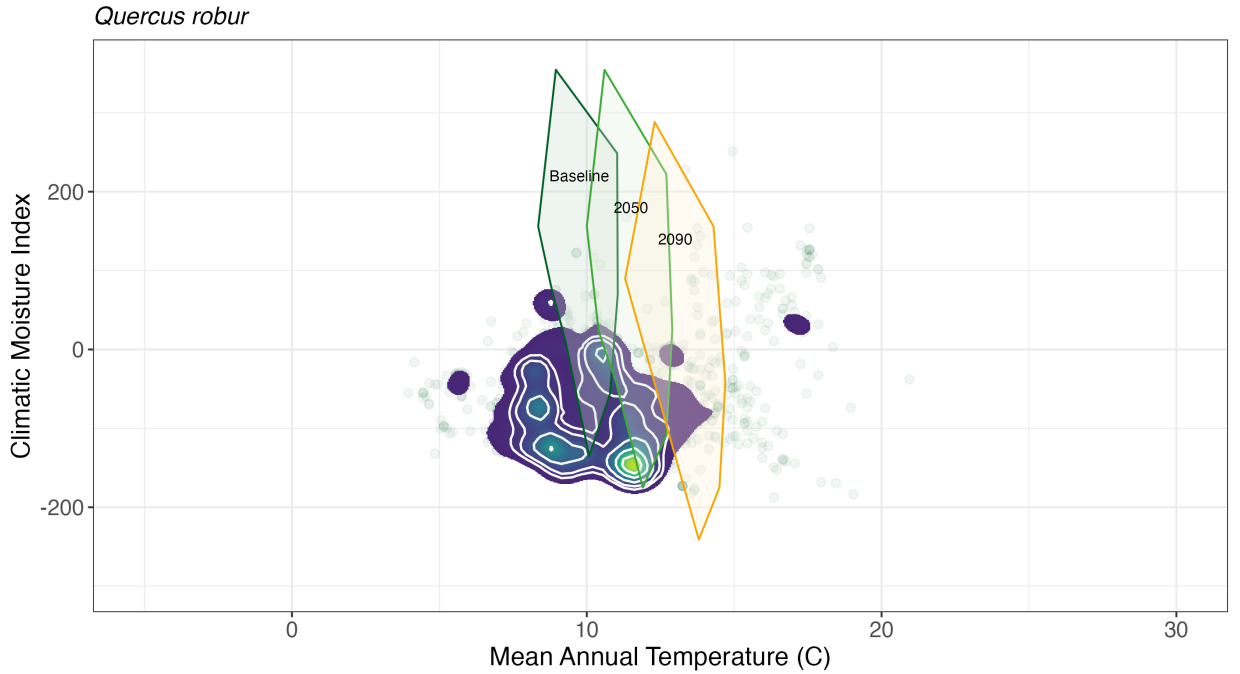


FIGURE 30: The changing suitability of pedunculate oak (*Quercus robur*) for major UK cities. Baseline represents the suitability based on the current long-term average climate. Both 2050 and 2090 scenarios are based on the SSP3 climate scenario.

KEY TO SUITABILITY | High suitability | Moderate suitability | Low suitability | Vulnerable

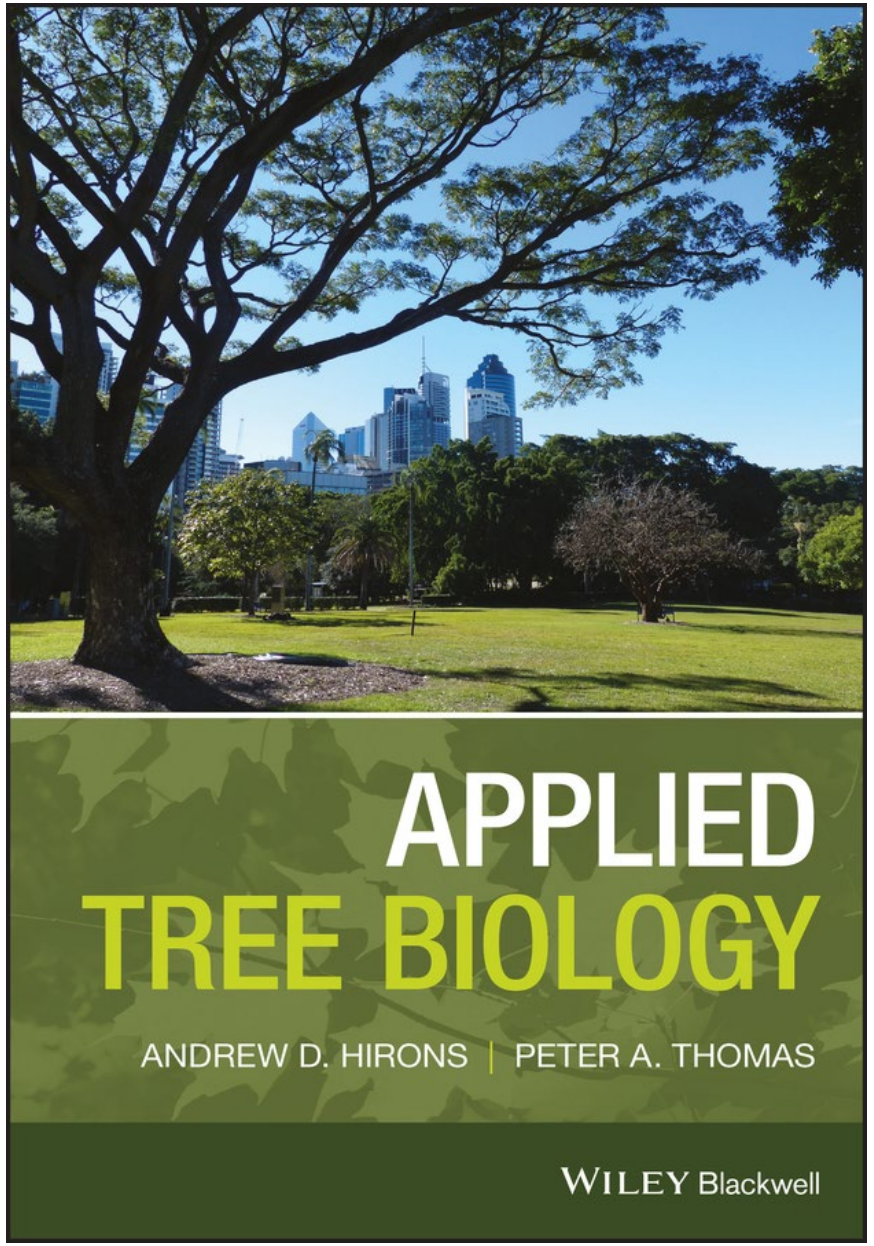
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ahirons@myerscough.ac.uk

Recommendation 1: Enhance the health of existing trees



1.1 – Prioritise investment in rooting environments – intentionally design space for roots, provide adequate soil volumes and promote healthy soils.
1.2 – Implement soil decompaction and improvement programmes for large, mature trees that deliver the greatest benefits.
1.3 – Recognise and resource tree health enhancement as a critical climate-adaptation action, not a maintenance activity.

Recommendation 2: Strategically diversify London's Urban Forest



2.1 – Increase taxonomic diversity within the constraints of species predicted to be suitable to London's future climate.
2.2 – Integrate pest, pathogen and invasiveness risk assessments with climate-suitability data to guide suitable species palettes.
2.3 – Embed these criteria into borough tree strategies, policy, procurement frameworks and design guidance.

Recommendation 3:
Fund tree establishment, not tree planting



3.1 – Require species suitability assessment, aftercare and establishment monitoring in funding agreements.
3.2 – Redesign grants and contracts to reward successful tree establishment (typically 5 years post-planting), not initial planting.
3.3 – Phase out numeric “trees planted” targets in favour of establishment success rate.

Recommendation 4:
Adopt a London tree data standard



4.1 – Implement a London-wide tree data framework covering taxonomy, measurement methods, and mortality reporting.

Recommendation 5: Collaborate with tree nurseries



5.1 – Provide nurseries with clear guidance on required species palettes.
5.2 – Establish nursery partnerships and contract-growing agreements to secure long-term supply of future climate-suitable and biosecure trees.
5.3 – Use collective London-level procurement to achieve economies of scale and ensure consistent stock quality.
5.4 – Where feasible, support climate-adapted tree production initiatives within London.

Recommendation 6:

Develop a strategic mechanism to get novel material into horticultural production



6.1 – Work with government bodies and industry to develop compliant mechanisms to introduce and trial new species and provenances suitable for future conditions.
6.2 – Support research on intraspecific variation in plant traits and targeted provenance selection to identify the most future climate-compatible planting material.
6.3 – Use botanic gardens and arboreta as hubs for research, testing, and knowledge transfer.

Recommendation 7:
Address gaps in plant trait data



7.1 – Support further research to address the ‘missing’ trait data gaps in wood density, leaf dry-matter content, and turgor-loss point for under-represented species.
7.2 – Establish a framework for collaboration between research institutions, policymakers and industry to continue to improve the evidence base for urban species selection.

Recommendation 8:

Evaluate potential canopy cover impacts of species climate suitability



8.1 – Once standardised data is adopted, use remote sensing (e.g. LiDAR) to map canopy structure and evaluate the impact of species on canopy cover.

Recommendation 9:

Develop London-wide strategies and structures to manage the whole of London's urban forest



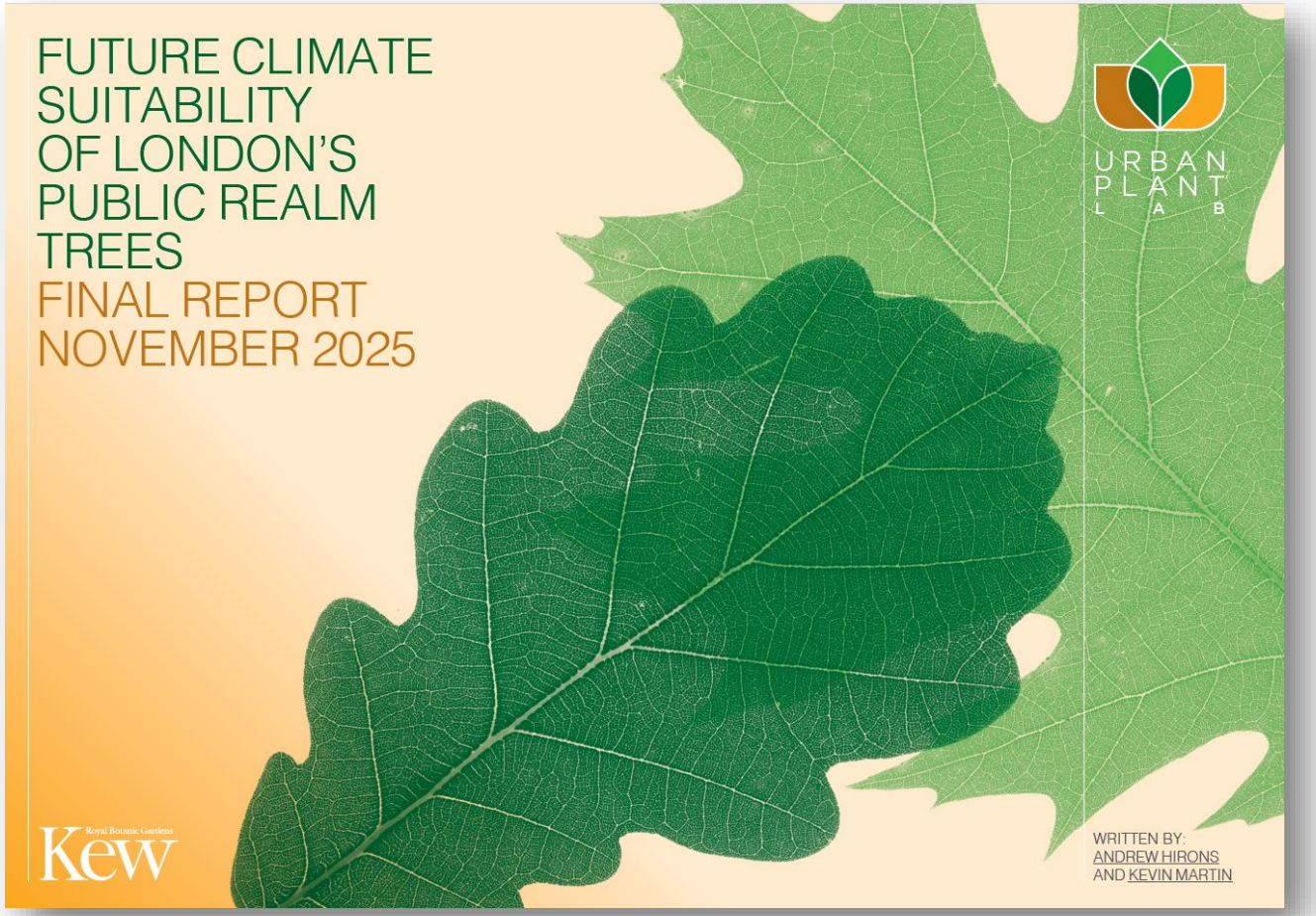
9.1 – Empower the London Urban Forest Partnership to coordinate data, investment, and planning for public realm trees across the city.

Recommendation 10: Enhance the health of existing trees



10.1 – Apply the methodology prototyped in London to assess the future climate suitability of trees to other UK cities and regions.
10.2 – Develop this analytical framework further to support a national evidence base for improving urban forest resilience within UK-wide climate adaptation policy.

Download the report



The Urban Plant Lab report on the *Future Climate Suitability of London's Public Realm Trees* is now out!

https://www.london.gov.uk/media/110943/download