Plant Hunter 2.0

Harry Watkins
harry@rootstock.me

A bit of background - how I got into tree hunting

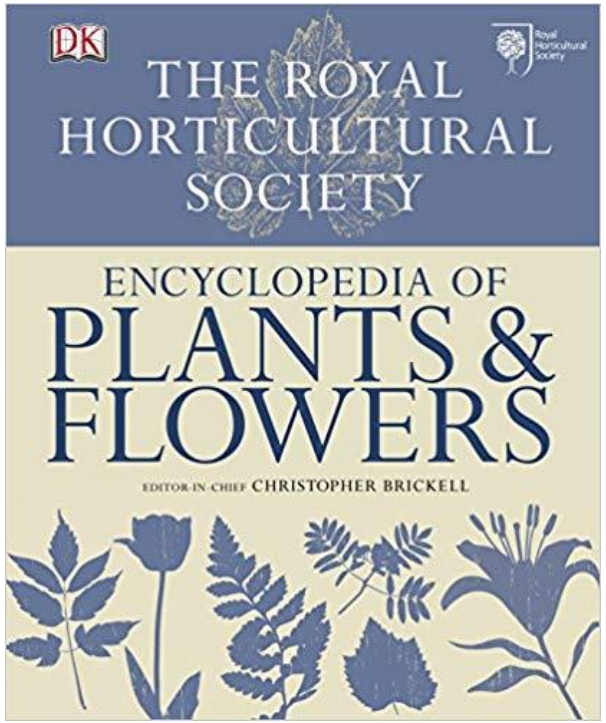
Climate Innovation District, Leeds, UK

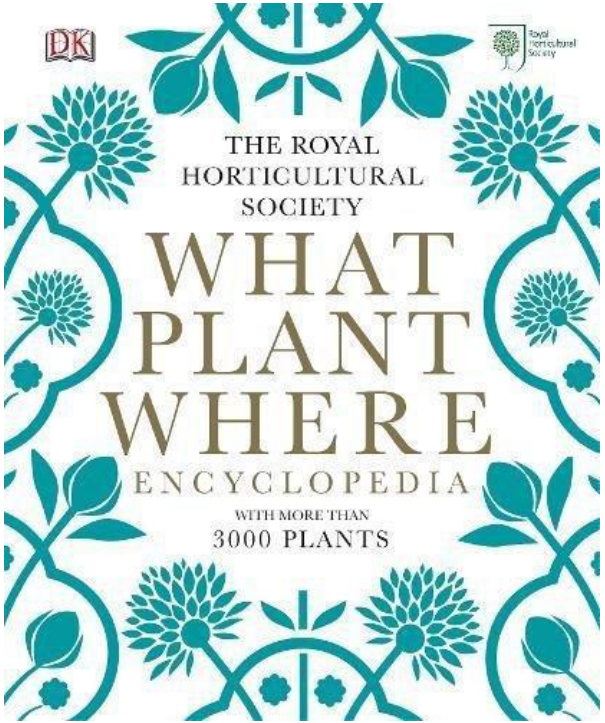

Barking Riverside, London

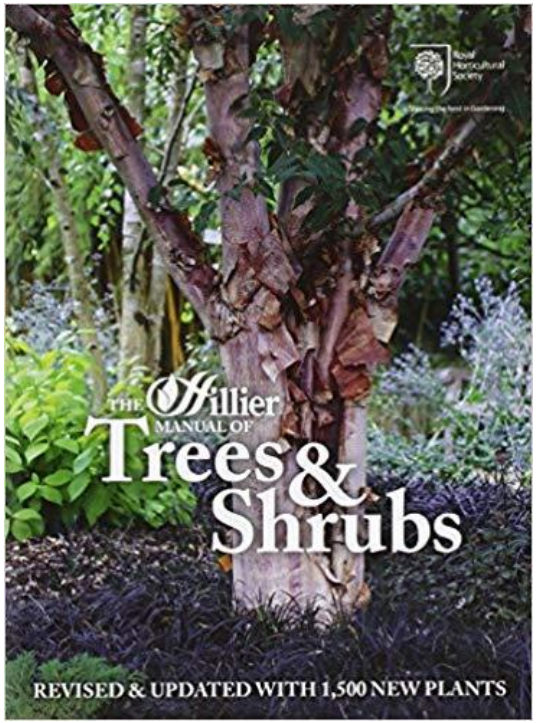

Simon Odell CMLI
@LI_SimonO
Following
I had a call from a contractor about a landscape designer being oblivious to the needs of trees when designing tree pits. There's lots of good 3rd-party guidance available. Perhaps @talklandscape recipients could RT with your own recommendations...
1:29 PM - 12 Mar 2019
1 Retweet 5 Likes
1
5
Tweet your reply

Publications	Target audience	Data
Plant identification and distribution resources[1]	Taxonomists, conservationists and horticulturists	Natural distribution of species or individuals, habitat in fundamental or realised niche
Trait literature[2]	Functional ecologists, dendrologists, botanists	Functional traits (e.g. SLA, SSD, Plant height) or functional type
Nursery catalogues[3]	Gardeners, landscape architects, landscape contractors, urban foresters	Plant size, floral or leaf aesthetics, resource requirement (eg water, light), soil conditions
Encyclopaedia[4]	Gardeners, landscape architects, urban foresters	Plant size, floral or leaf aesthetics, resource requirement (eg water, light), soil conditions
Horticultural monographs[5]	Gardeners, landscape architects, botanic gardens and arboretums	Plant size, floral or leaf aesthetics, resource requirement (eg water, light), soil conditions
Industry guidance[6]	Landscape architects, landscape contractors, urban foresters	Plant size, floral or leaf aesthetics, resource requirement (eg water, light), soil conditions, management requirements

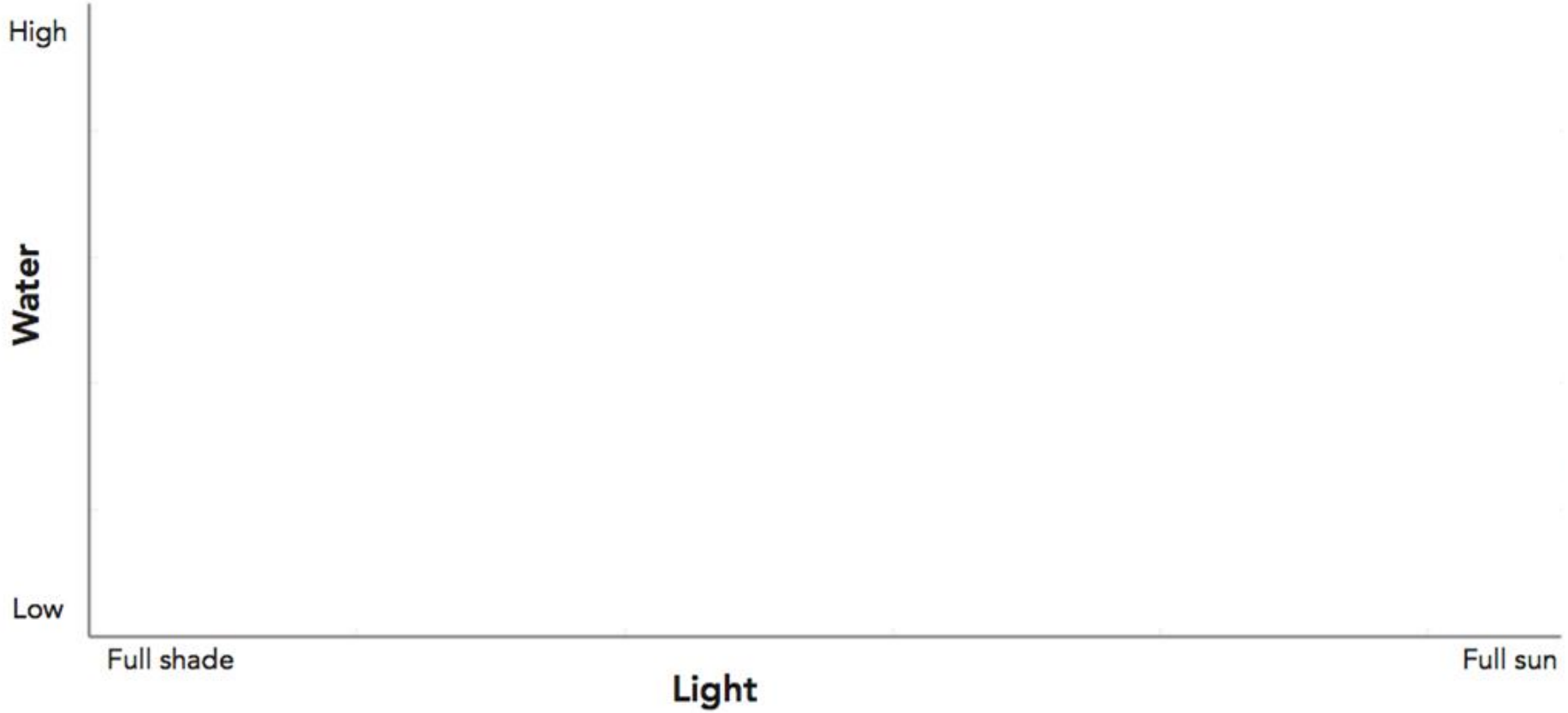
Is the horticultural literature fit for purpose?



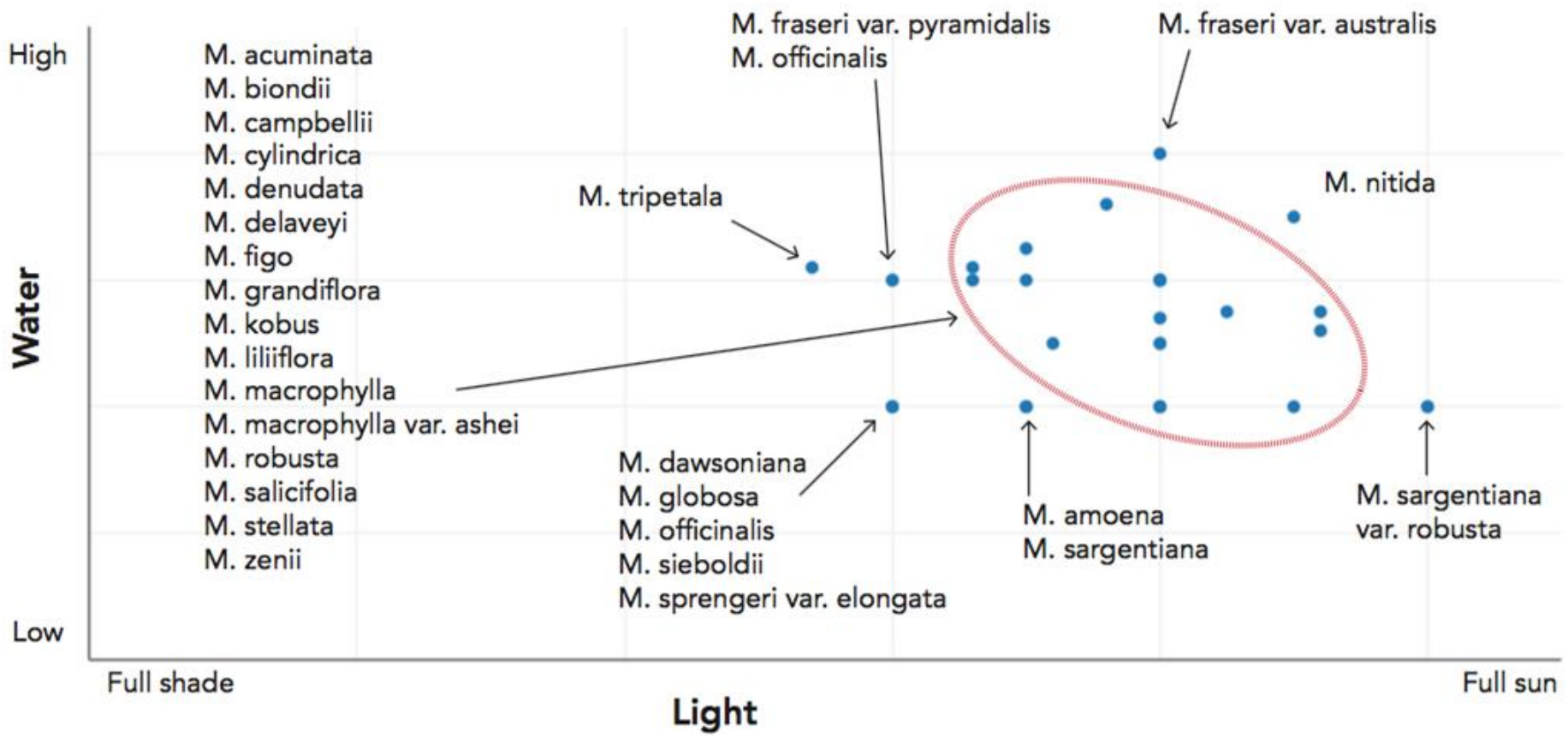




Magnolia growing conditions in the horticultural literature



Magnolia growing conditions in the horticultural literature



Plant hunting

Why we still need to look for trees in the wild in the 21st century

1. Principles of plant ecology
2. Research - finding trees that can handle climate breakdown
3. Next steps

Principles of plant ecology

Two main factors limit plant growth

Stress

Two main factors limit plant growth

Stress and Disturbance

Two main factors limit plant growth

Stress and Disturbance

Two main factors limit plant growth

Stress and Disturbance

low stress + high disturbance = live fast, die young

Two main factors limit plant growth

Stress and Disturbance

high stress + low disturbance = slow and steady

Two main factors limit plant growth

Stress and Disturbance

low stress + low disturbance = outcompete everyone else

Two main factors limit plant growth

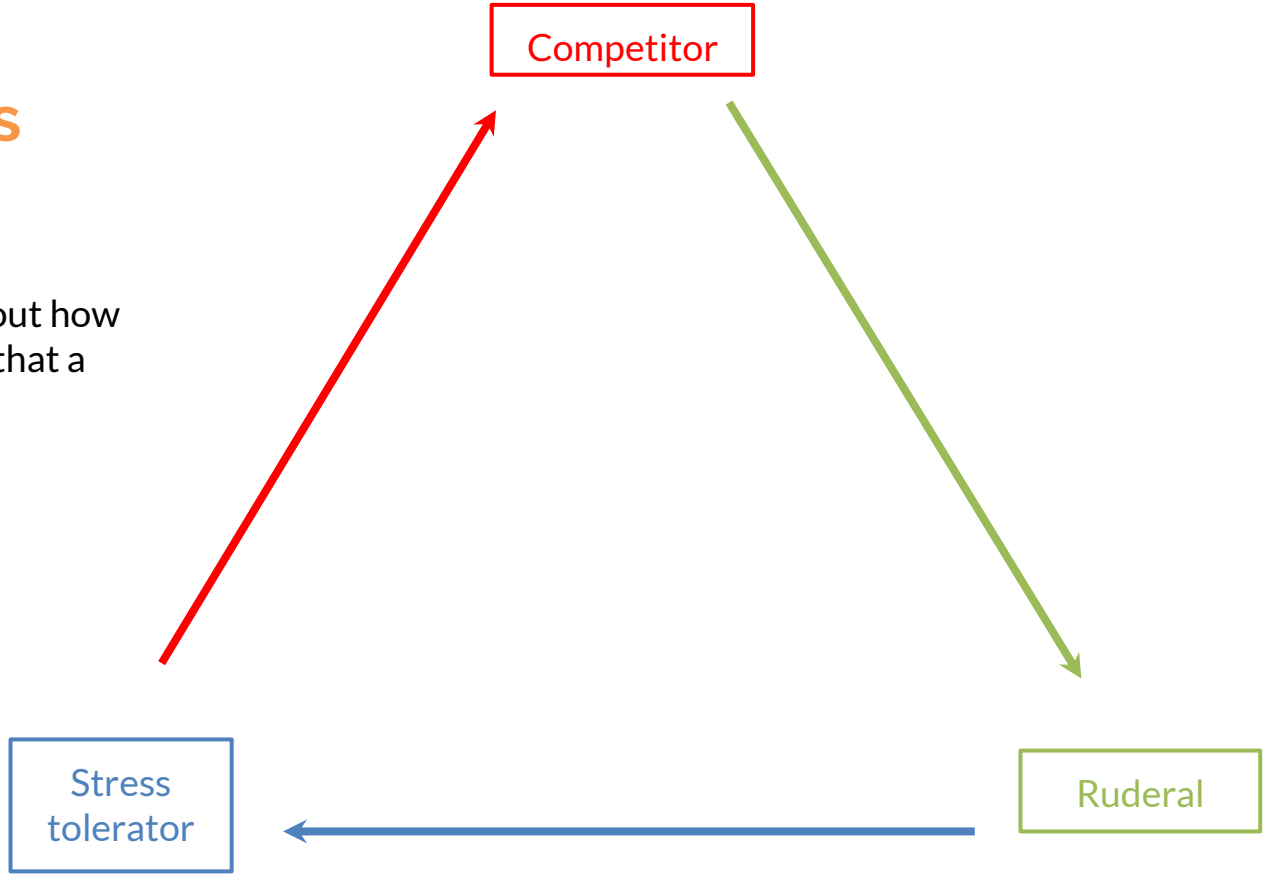
Stress and Disturbance

high stress + high disturbance = no viable strategy for life

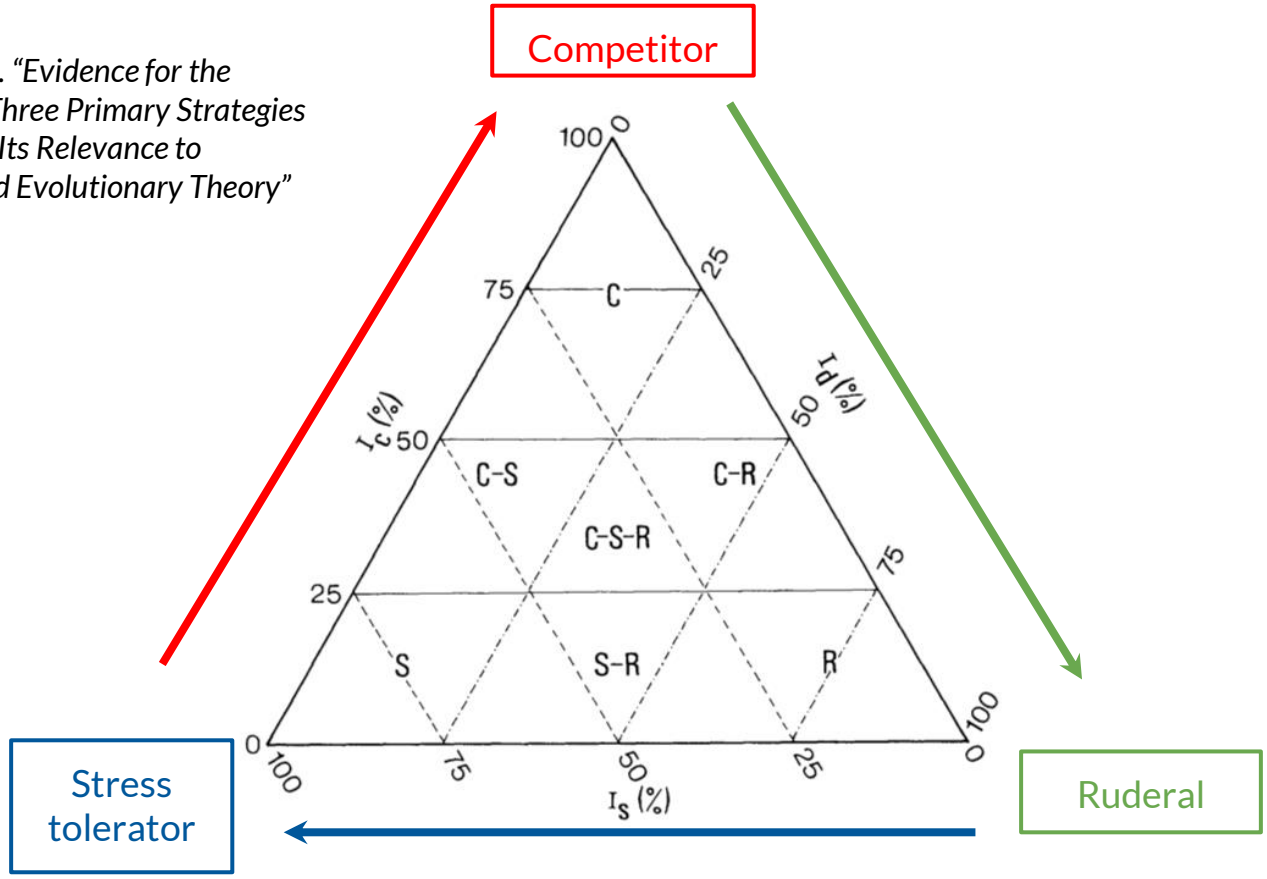
Plant economics lead to trade-offs

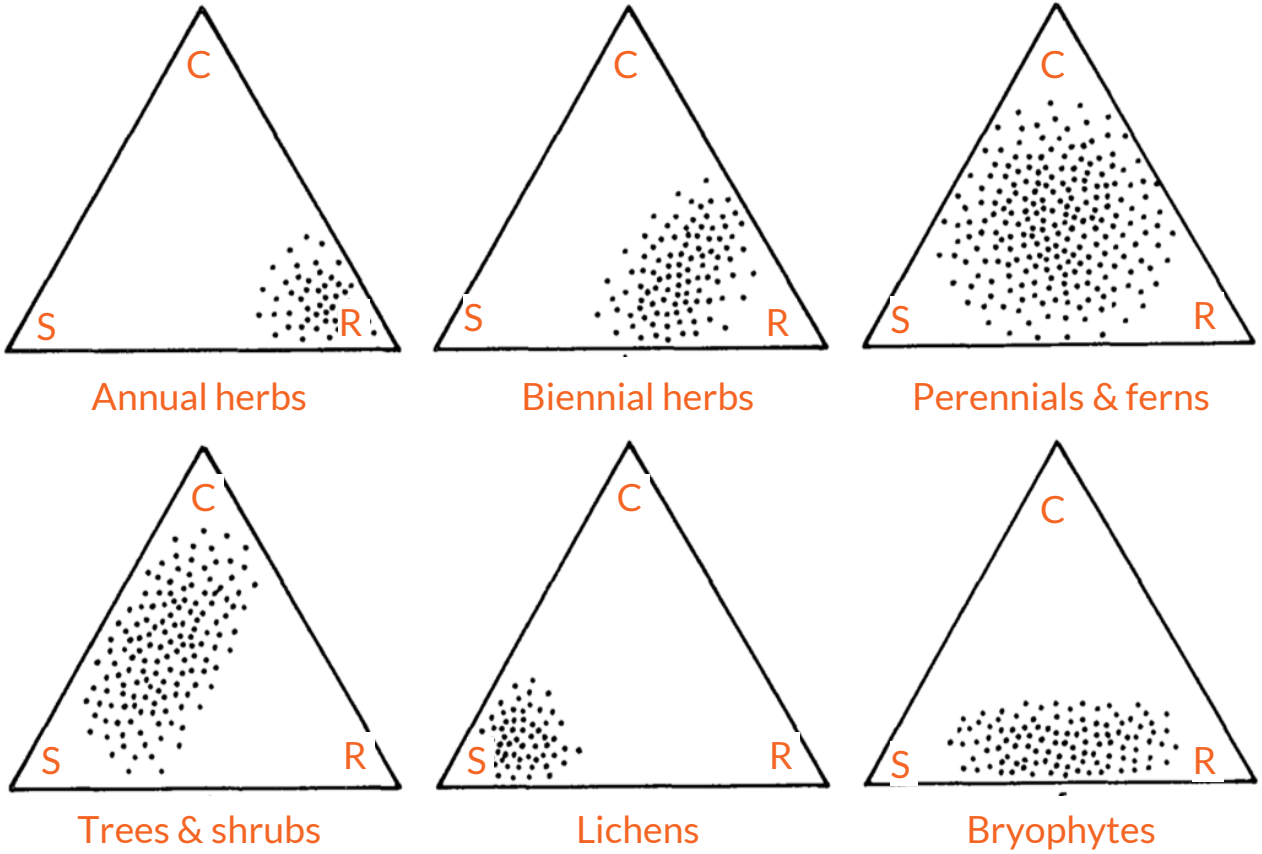
You can't do everything

A decision needs to be made about how to allocate every unit of carbon that a plant produces



Grime, 1977. *"Evidence for the Existence of Three Primary Strategies in Plants and Its Relevance to Ecological and Evolutionary Theory"*

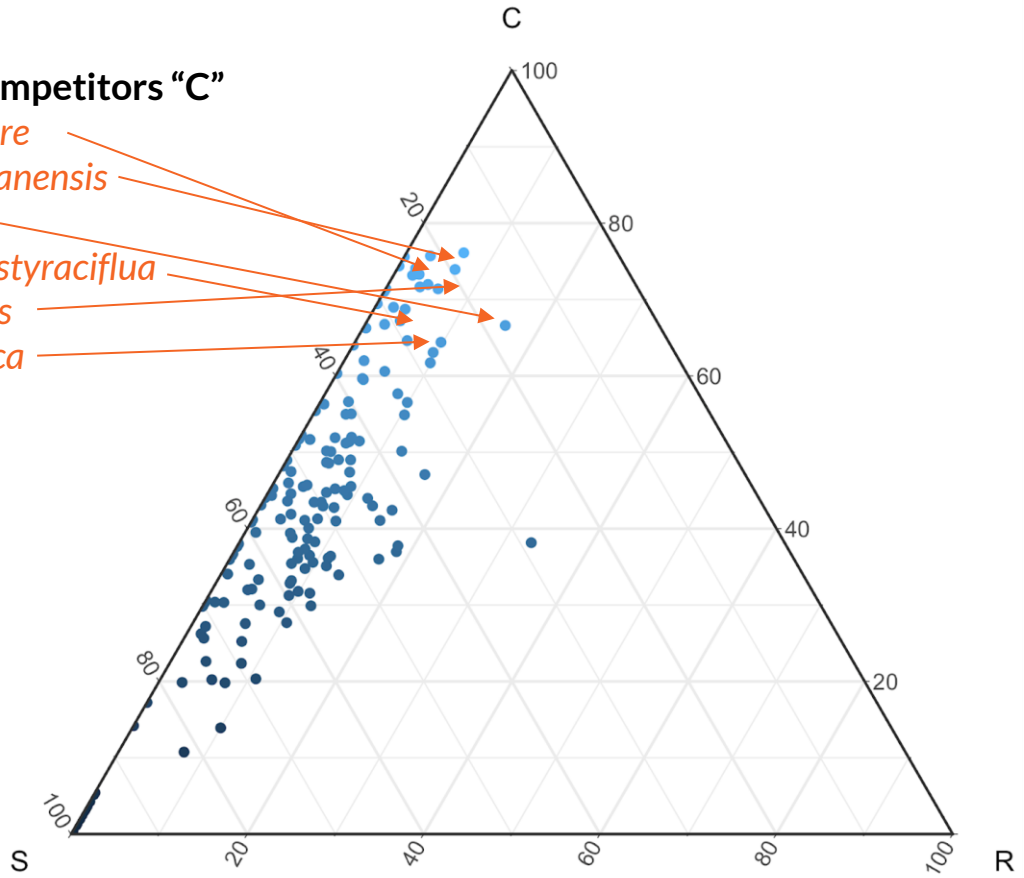




Strategies for life: major plant groups

Specialist competitors “C”

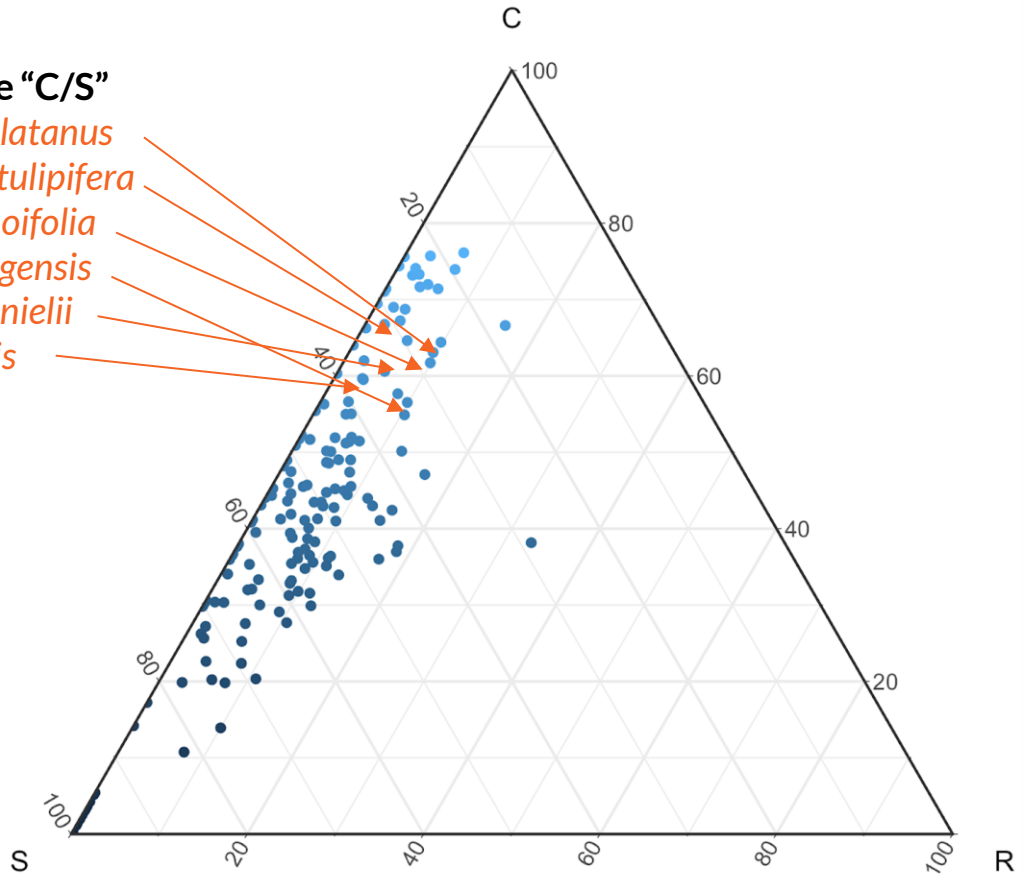
Acer campestre
Betula allaghanensis
Corylus ferox
Liquidambar styraciflua
Quercus cerris
Tilia mongolica



Evaluation of trees growing in Alnarp Arboretum, Sweden *(Sjoman & Watkins, 2019)*

Intermediate “C/S”

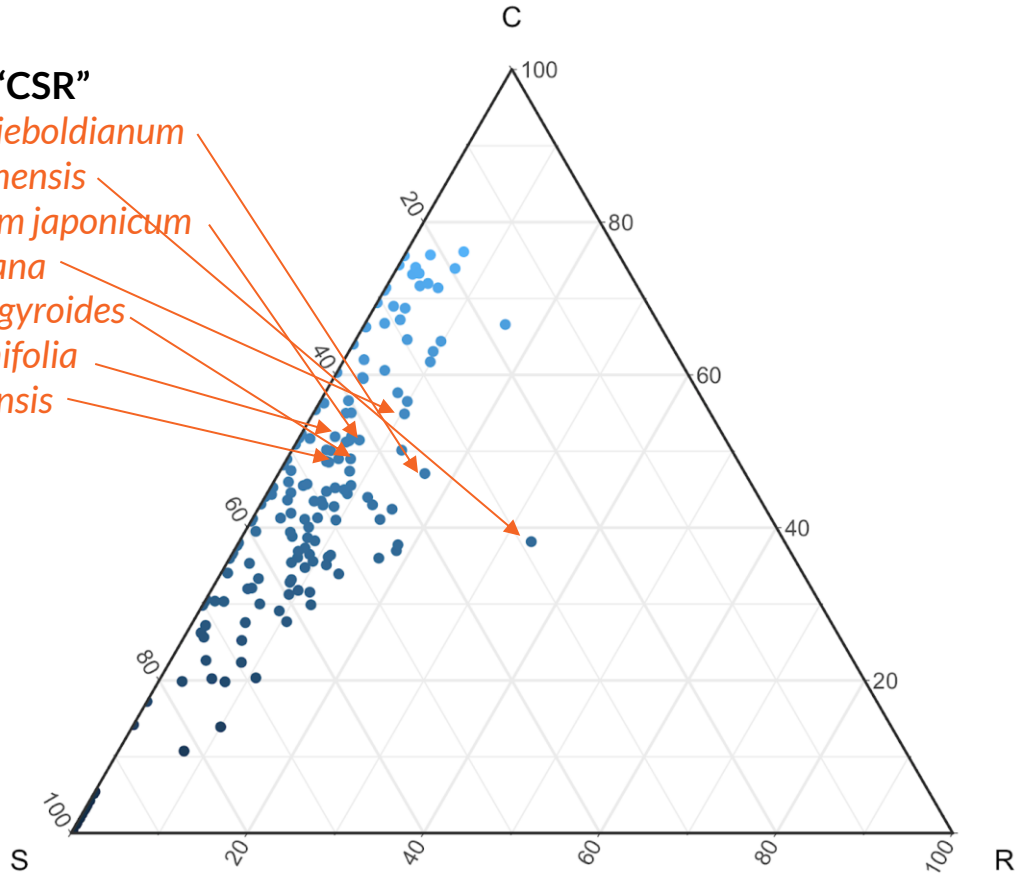
Acer pseudoplatanus
Liriodendron tulipifera
Pterocarya rhoifolia
Sorbus ulleungensis
Tetradium danielii
Toona sinensis



Evaluation of trees growing in Alnarp Arboretum, Sweden *(Sjoman & Watkins, 2019)*

Generalists “CSR”

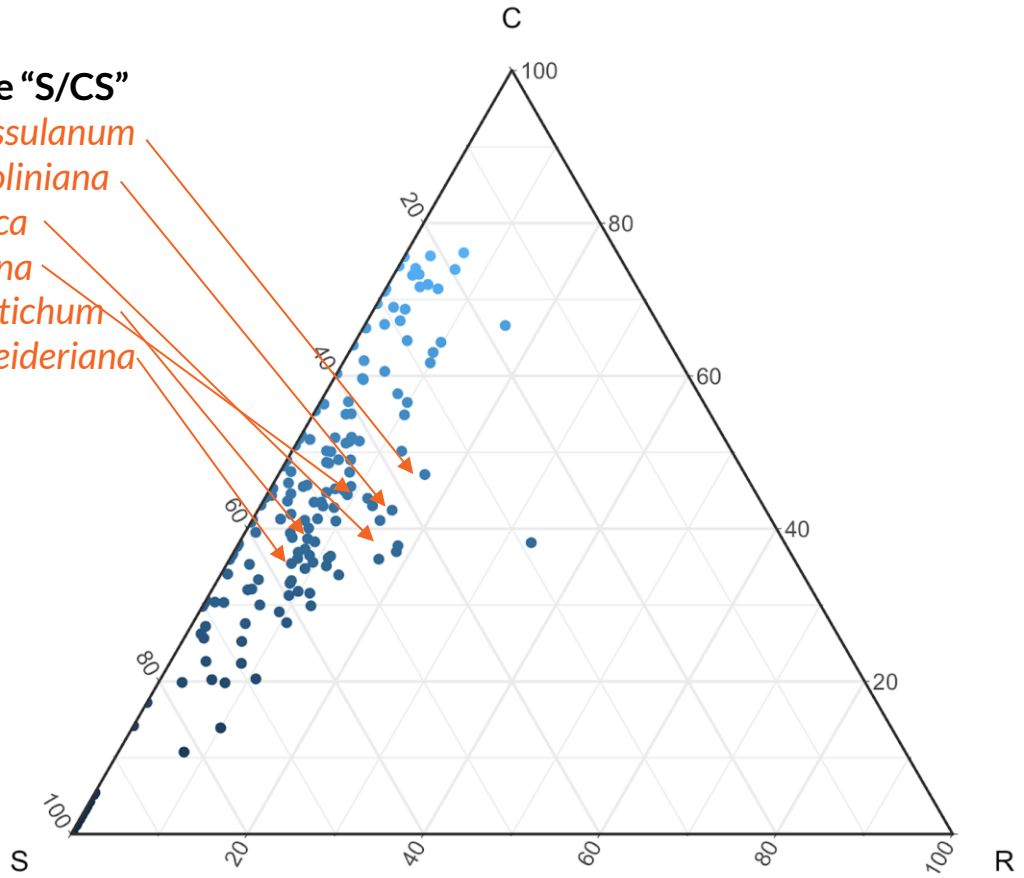
Acer pseudosieboldianum
Betula albosinensis
Cercidiphyllum japonicum
Corylus avellana
Laburnum angyroides
Ostrya carpinifolia
Pyrus ussuriensis



Evaluation of trees growing in Alnarp Arboretum, Sweden *(Sjoman & Watkins, 2019)*

Intermediate “S/CS”

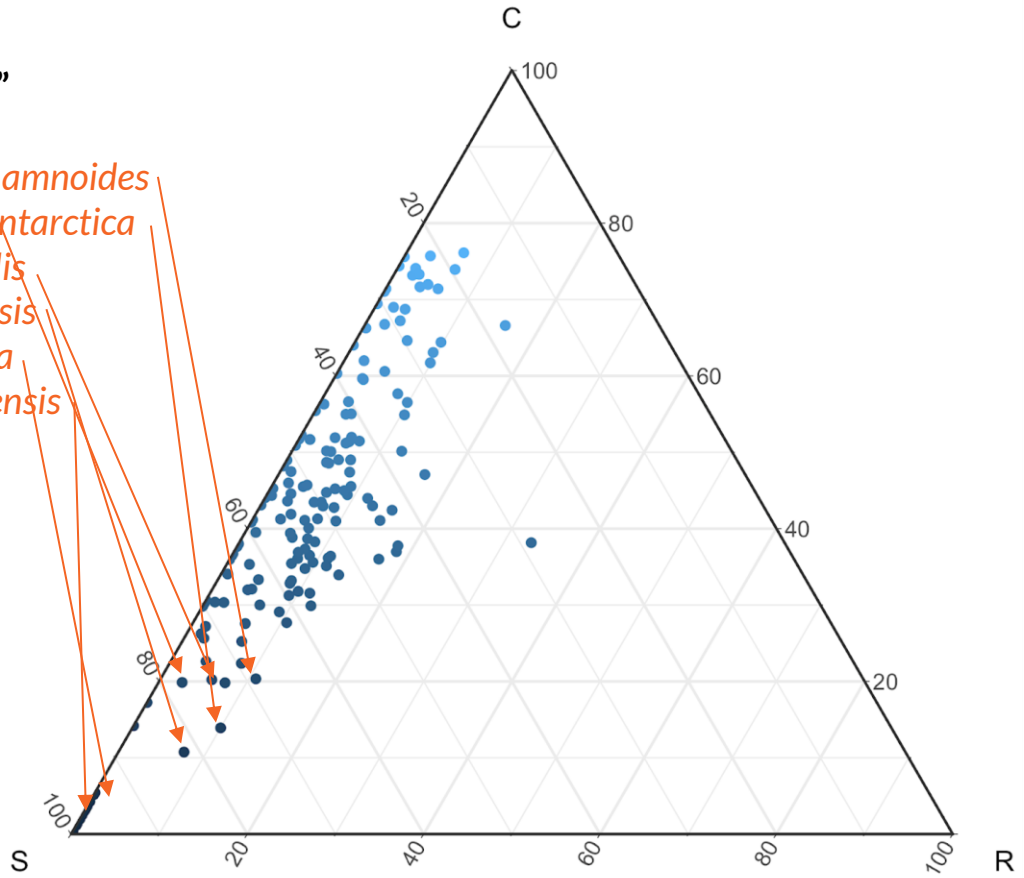
Acer monspessulanum
Carpinus caroliniana
Nyssa sylvatica
Prunus serotina
Taxodium distichum
Zelkova schneideriana



Evaluation of trees growing in Alnarp Arboretum, Sweden *(Sjoman & Watkins, 2019)*

Specialist “S”

Abies alba
Hippophae rhamnoides
Nothofagus antarctica
Picea orientalis
Picea koraiensis
Taxus baccata
Tsuga canadensis



Evaluation of trees growing in Alnarp Arboretum, Sweden *(Sjoman & Watkins, 2019)*

But - what about intraspecific variation?

How can we account for genotypes & phenotypes... and do they matter to landscape architects?

Research - finding trees that can handle climate breakdown

Research strategies using Magnolias as a case study

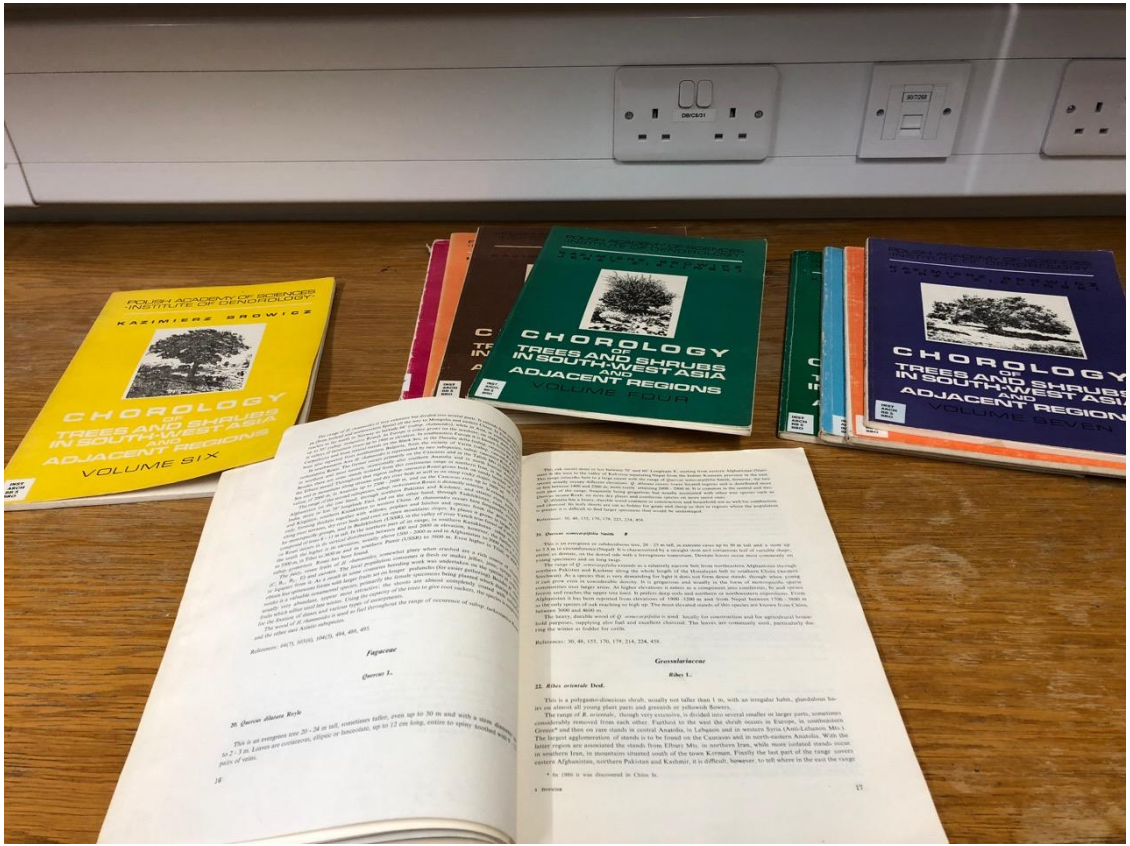
(a) **Biogeography**

Investigating species' distribution and niches, using Big Data

(b) **Functional traits**

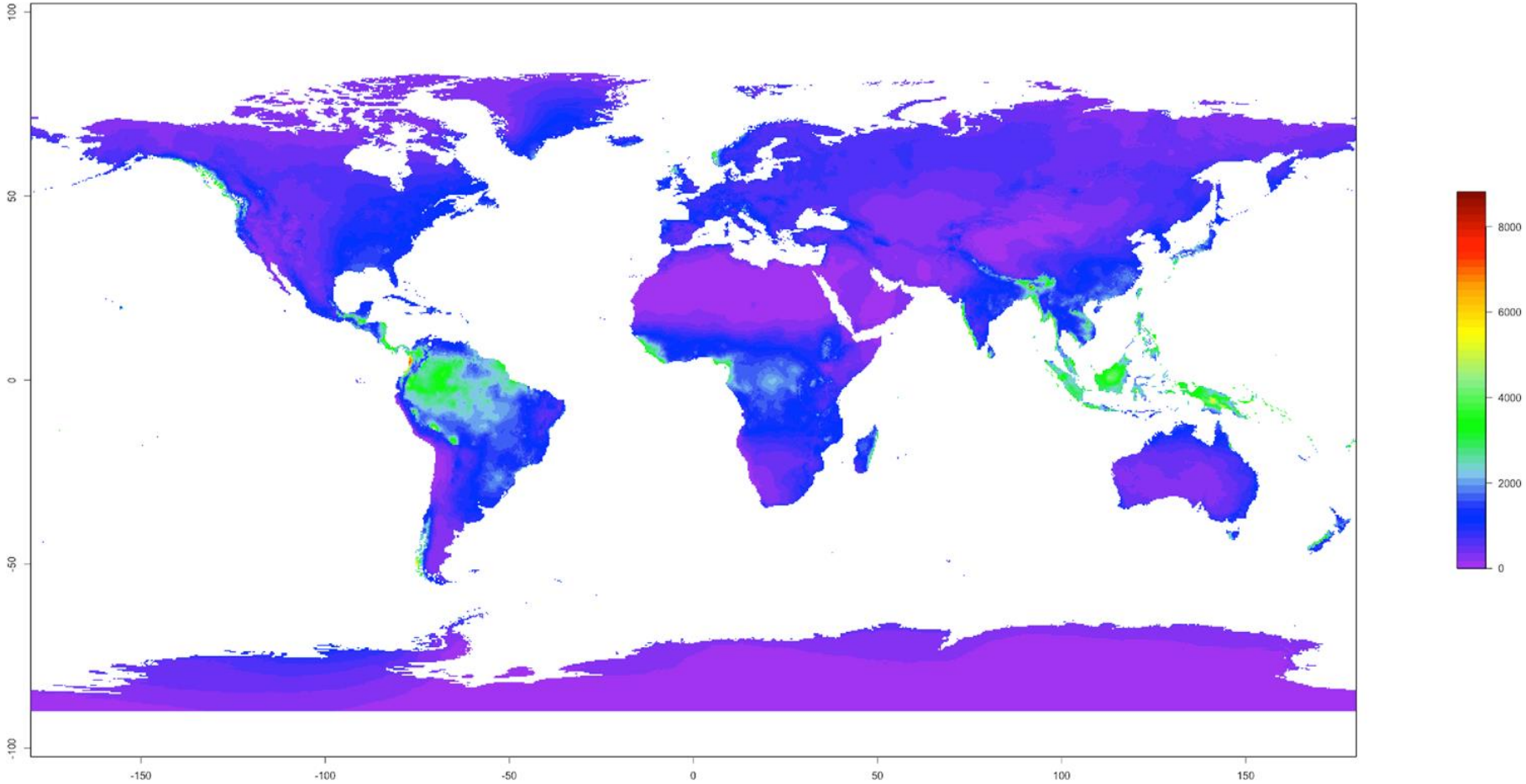
Looking at plant physiology to understand resource allocation and whole-plant strategies

Biogeographical research: building a database of verified locations, recording where and when Magnolias have been seen in the wild

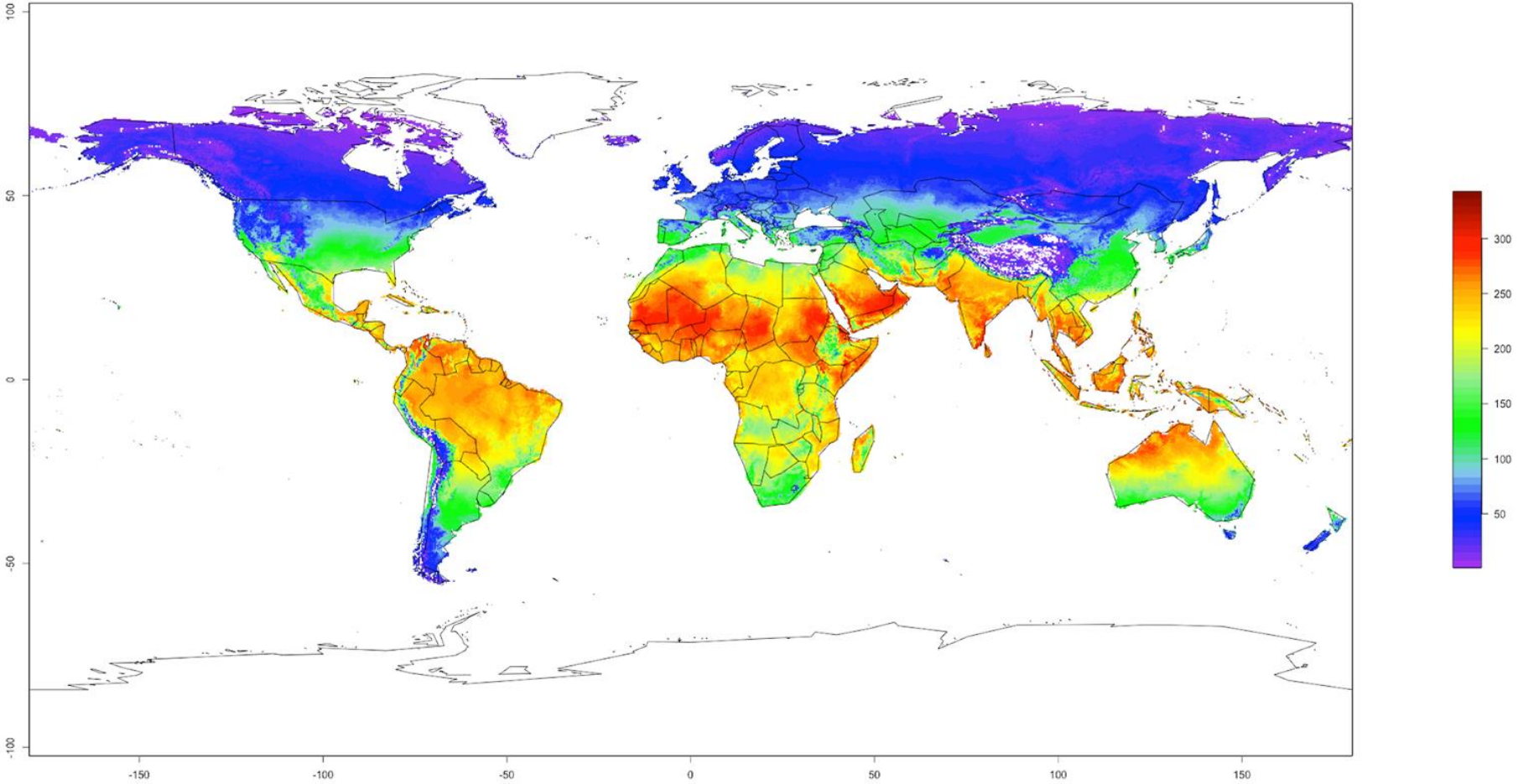


Desk-based research, using herbarium samples and records of expeditions and fieldwork by botanists

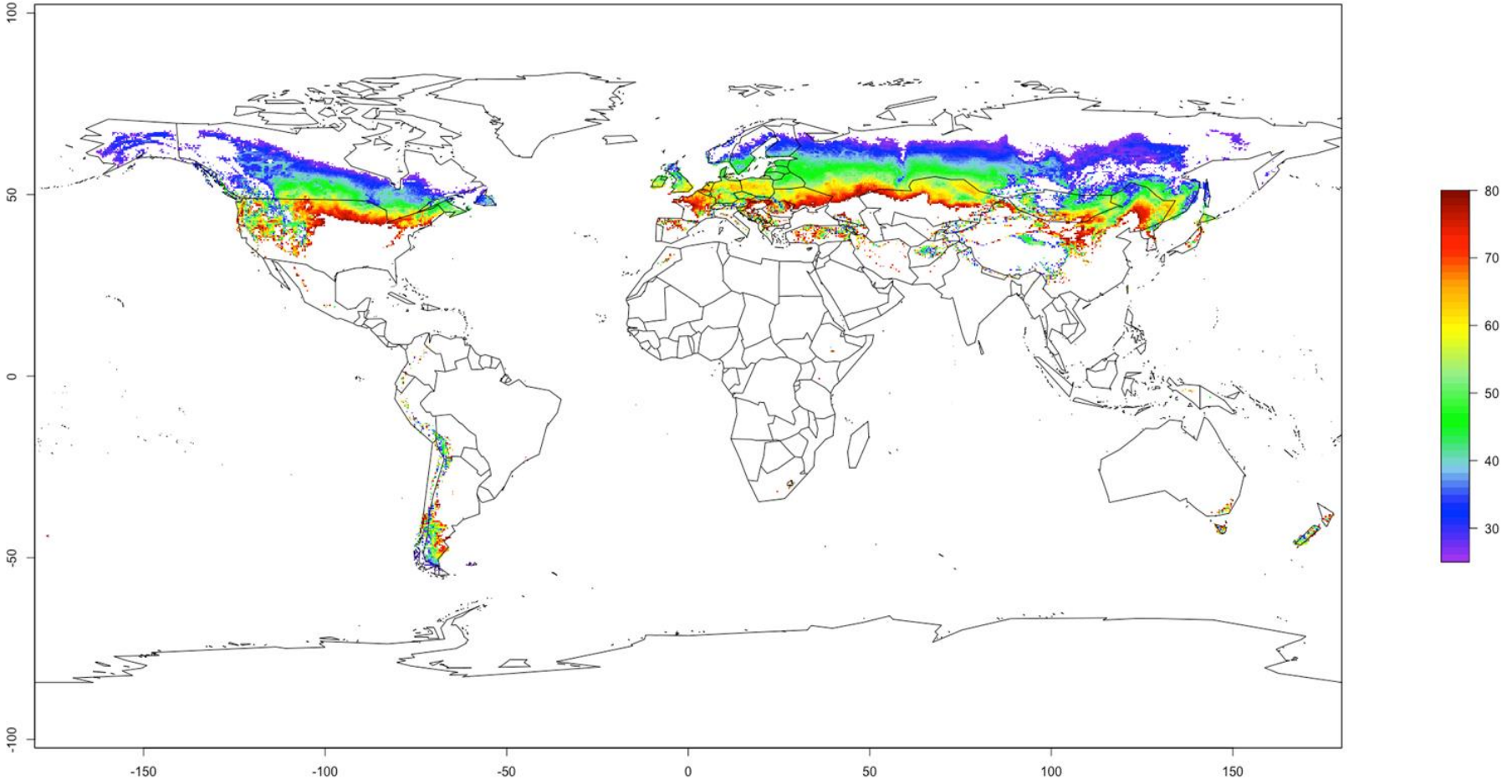
Global climate: total annual rainfall



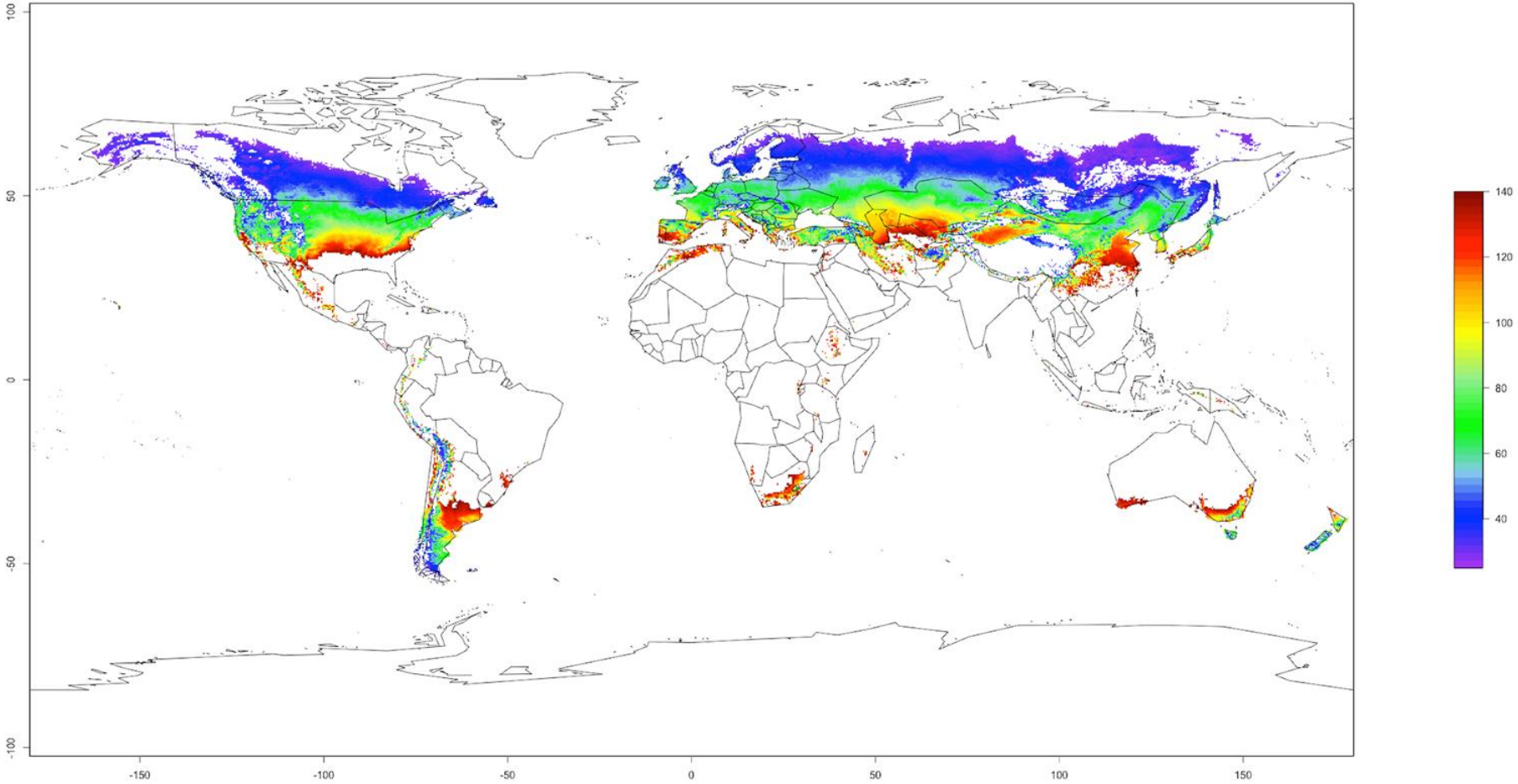
Global climate: warmth index

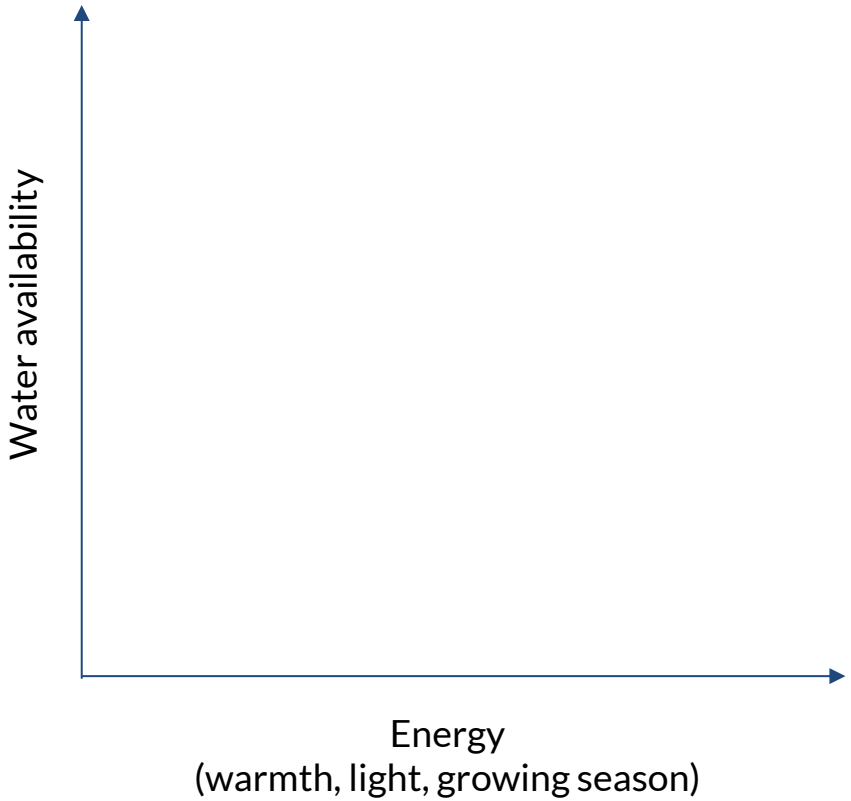


Global climate: locations with warmth index similar to NW Europe

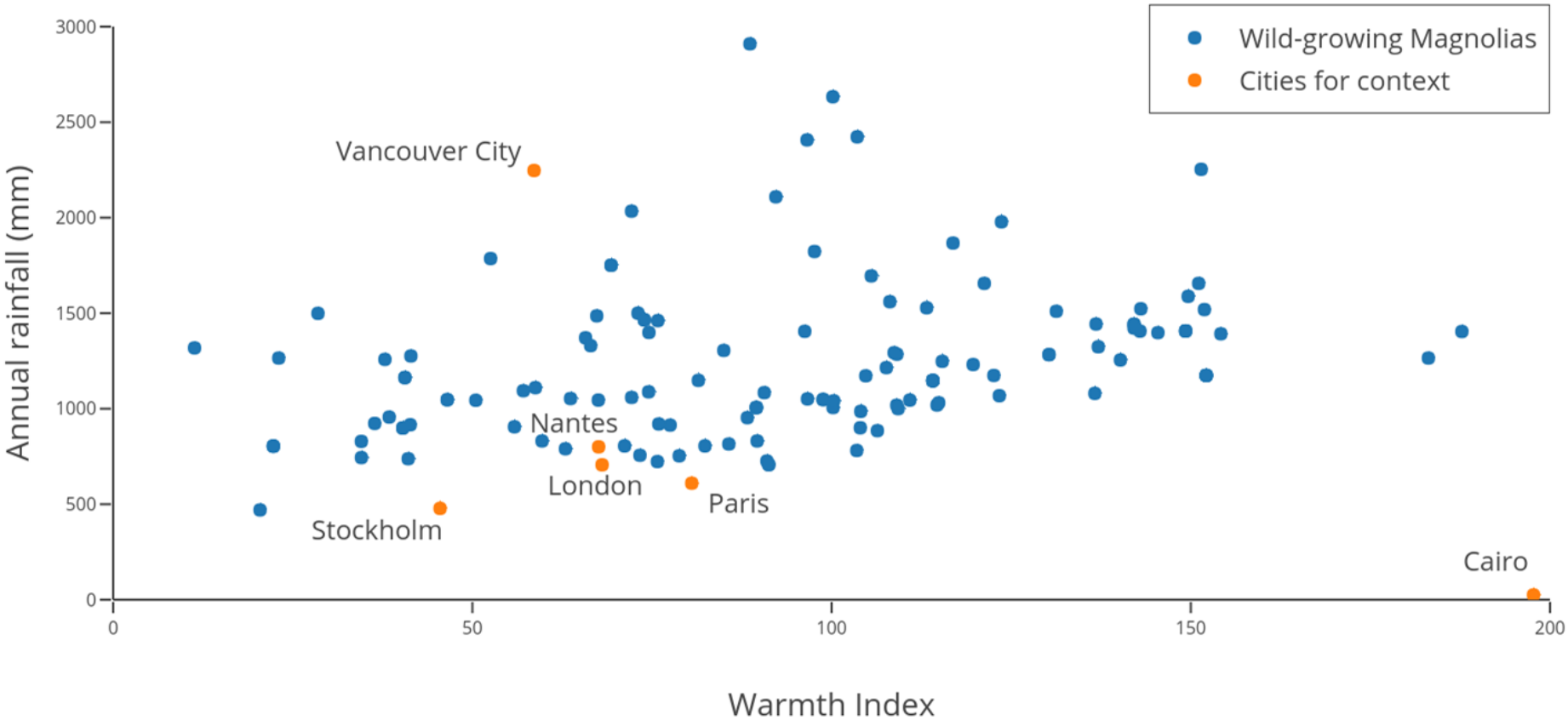


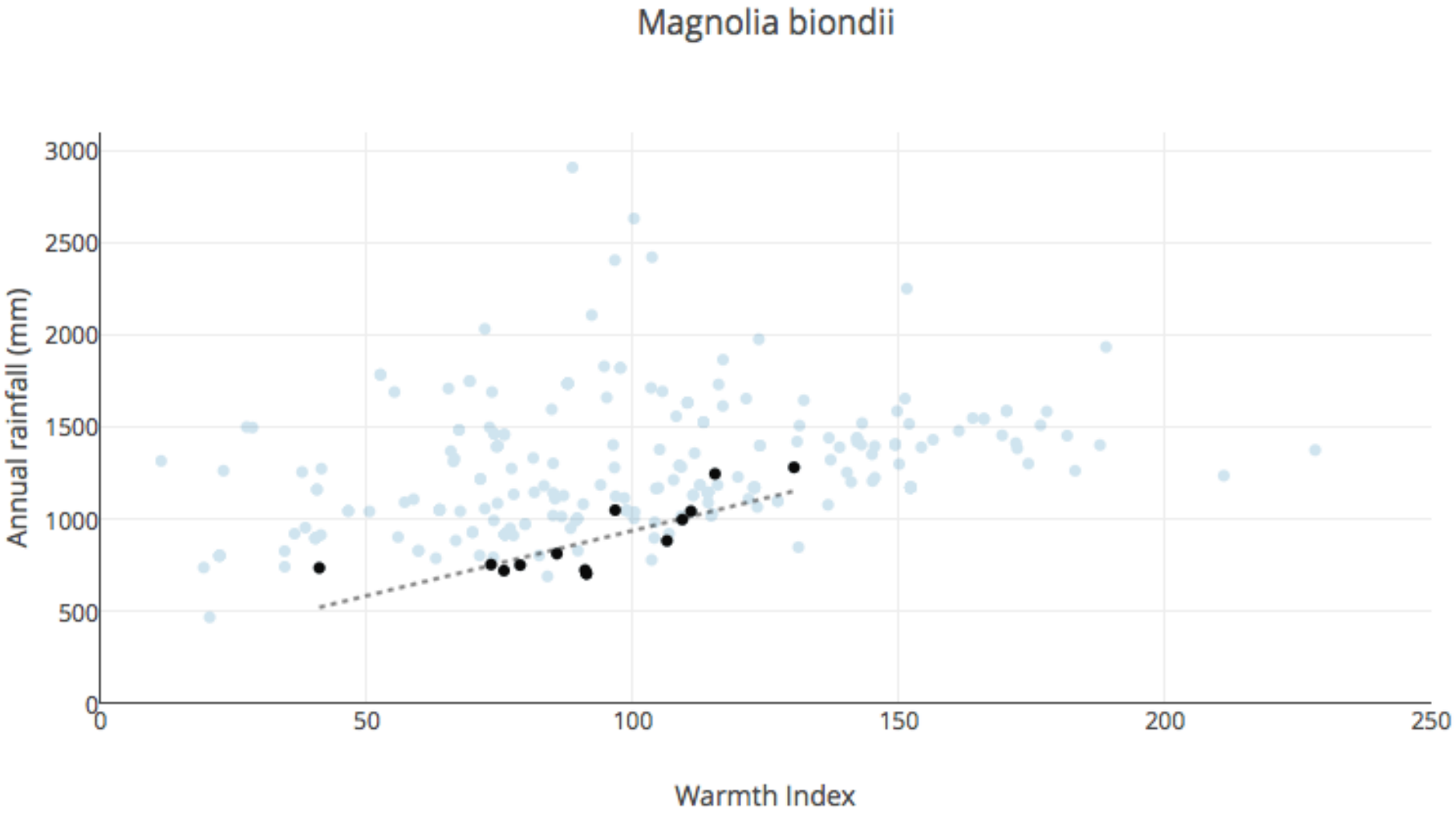
Global climate: locations with warmth index similar to NW Europe under climate change

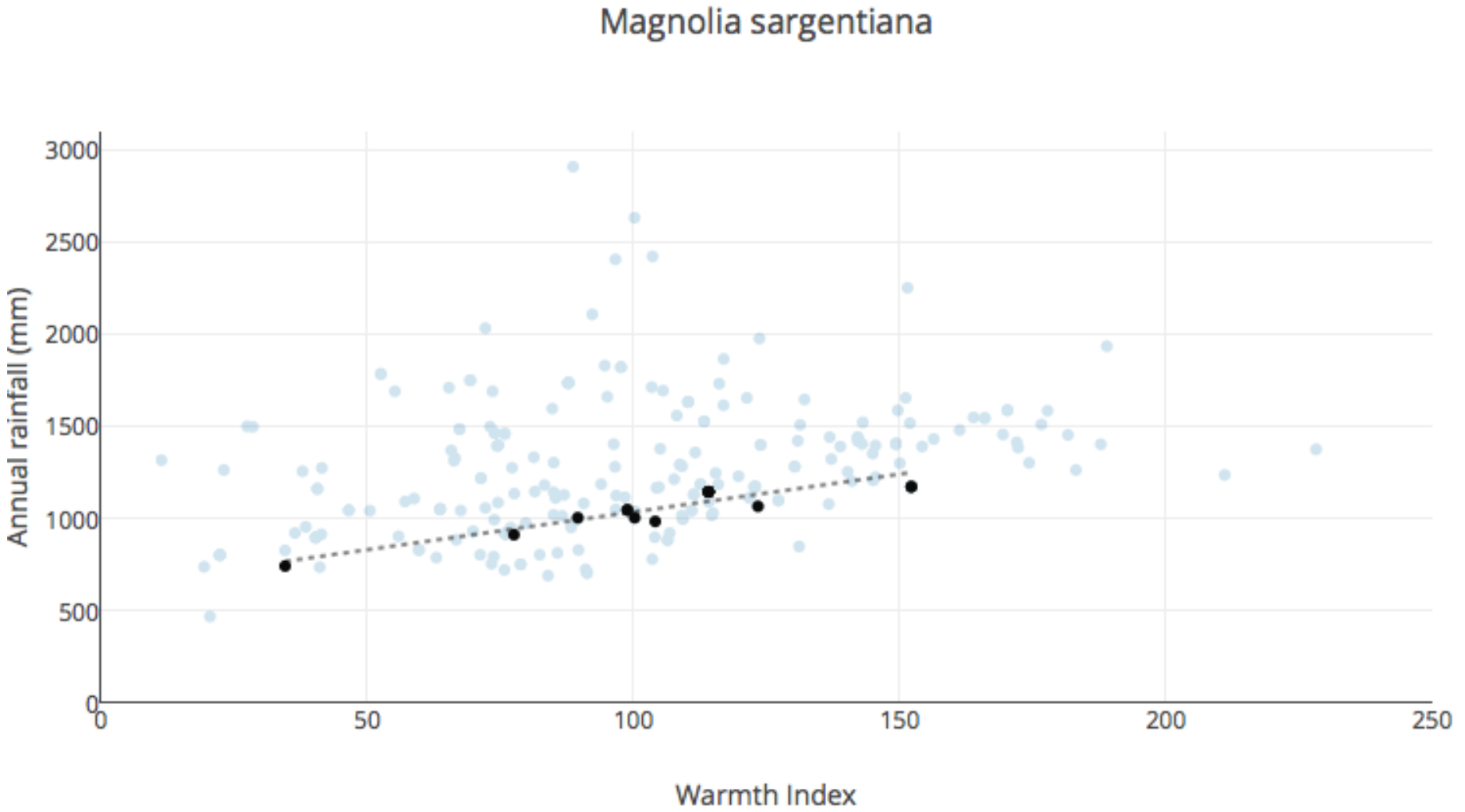


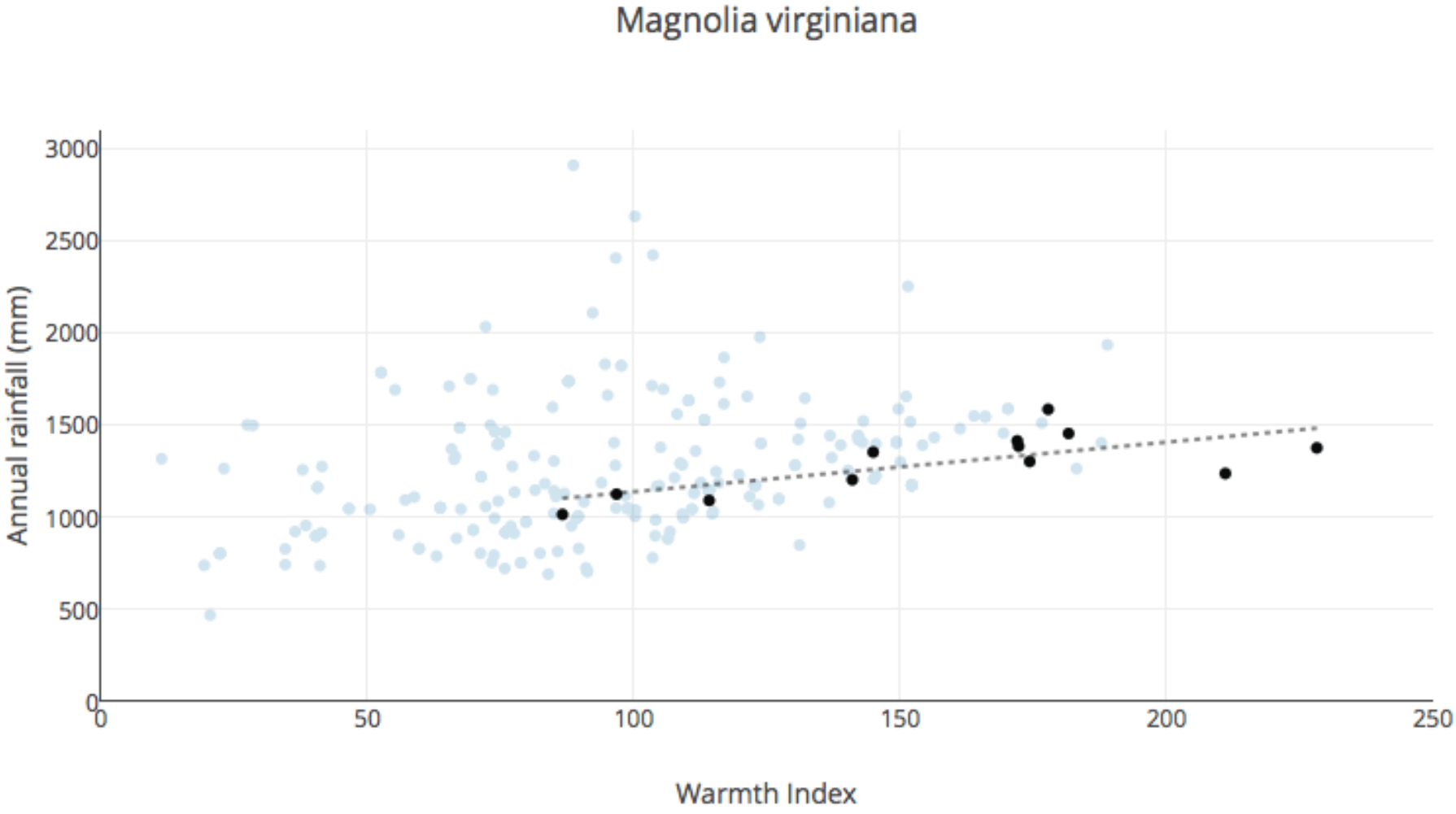


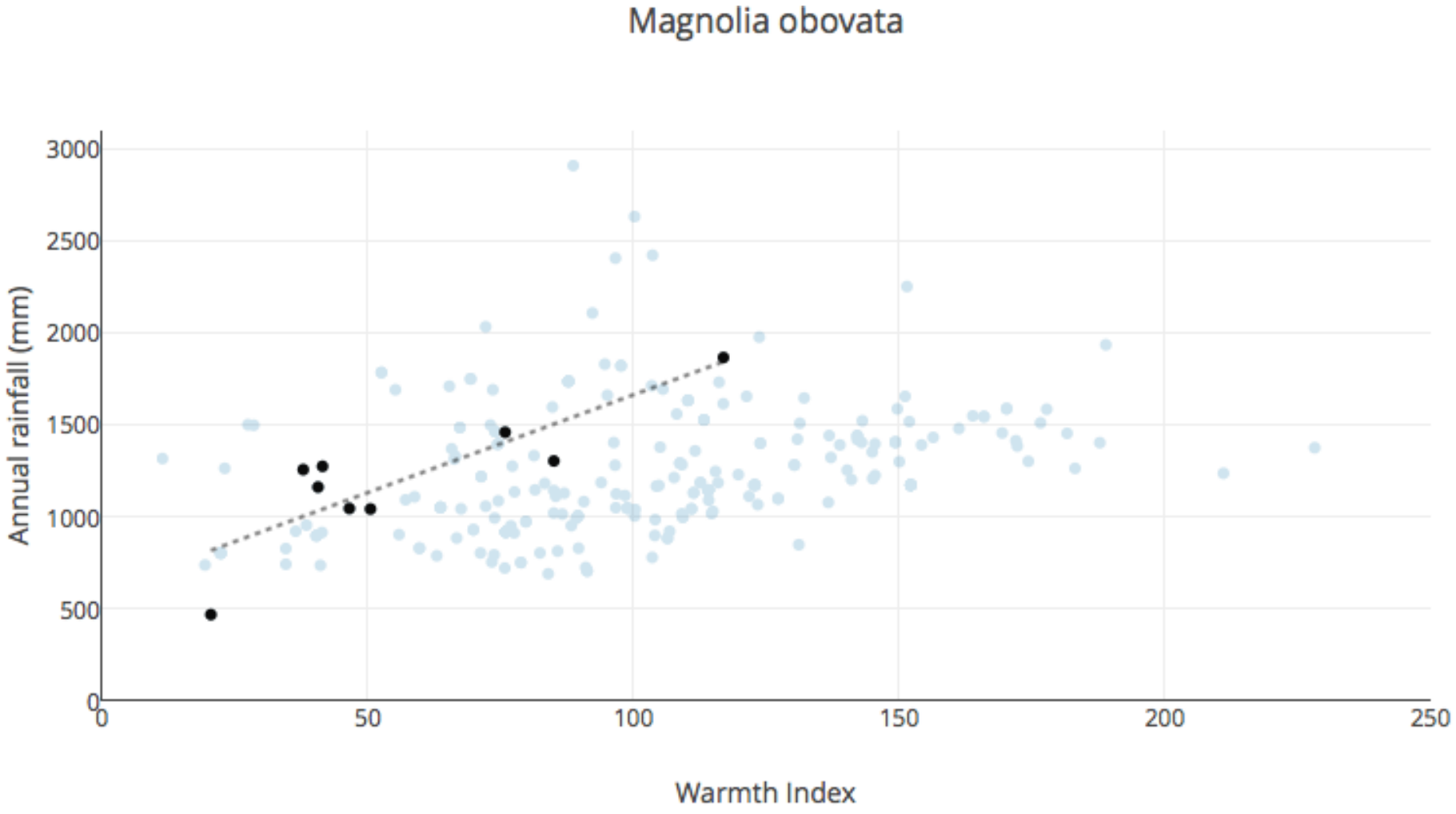
We can map species' niches by plotting climate conditions in their natural range

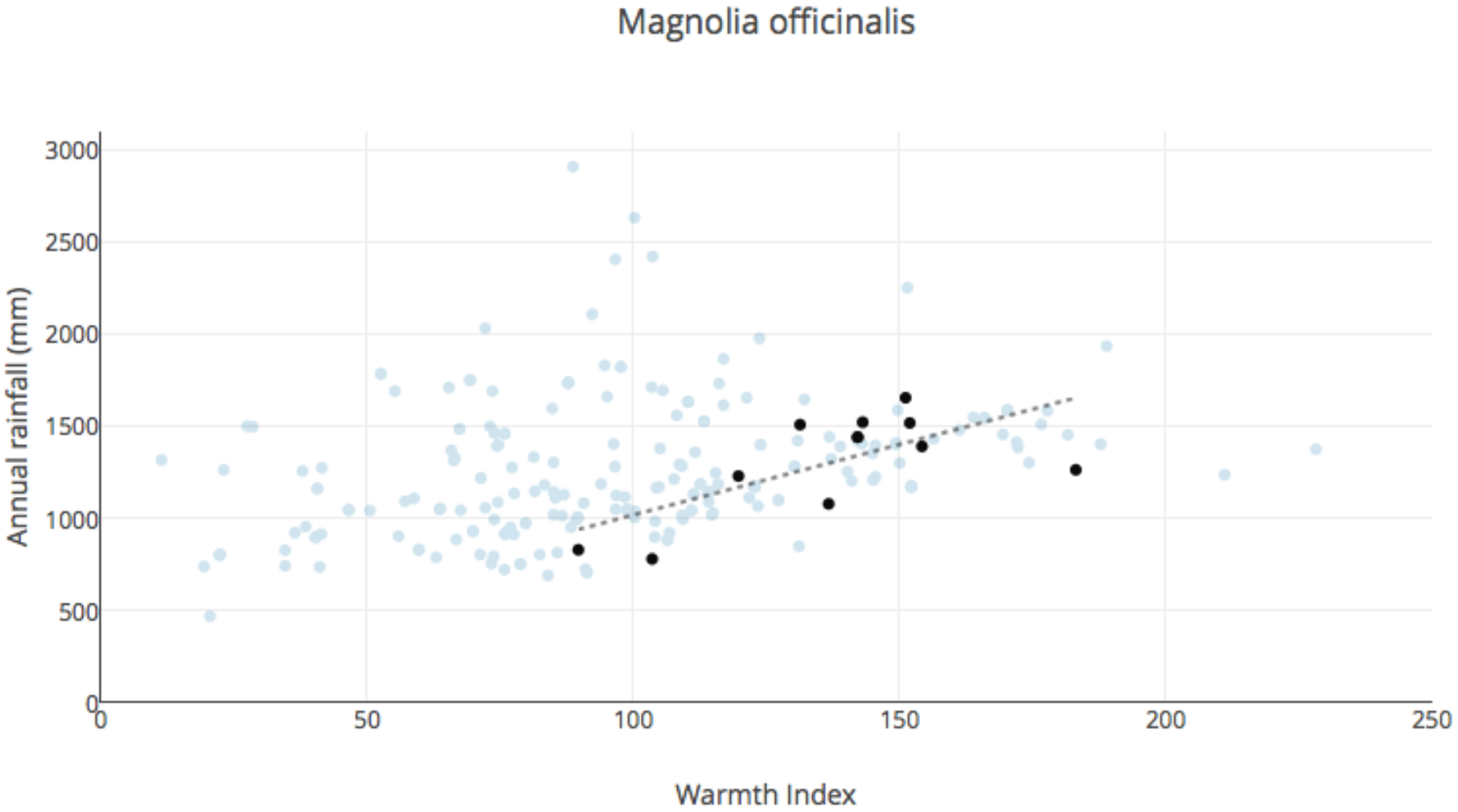

Wild-growing Magnolias
Cities for context
Annual rainfall (mm)
3000
2500
2000
1500
1000
500
0
Vancouver City
Nantes
London
Paris
Stockholm
Cairo
0
50
100
150
200
Warmth Index


Magnolia biondii
Annual rainfall (mm)
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
Warmth Index

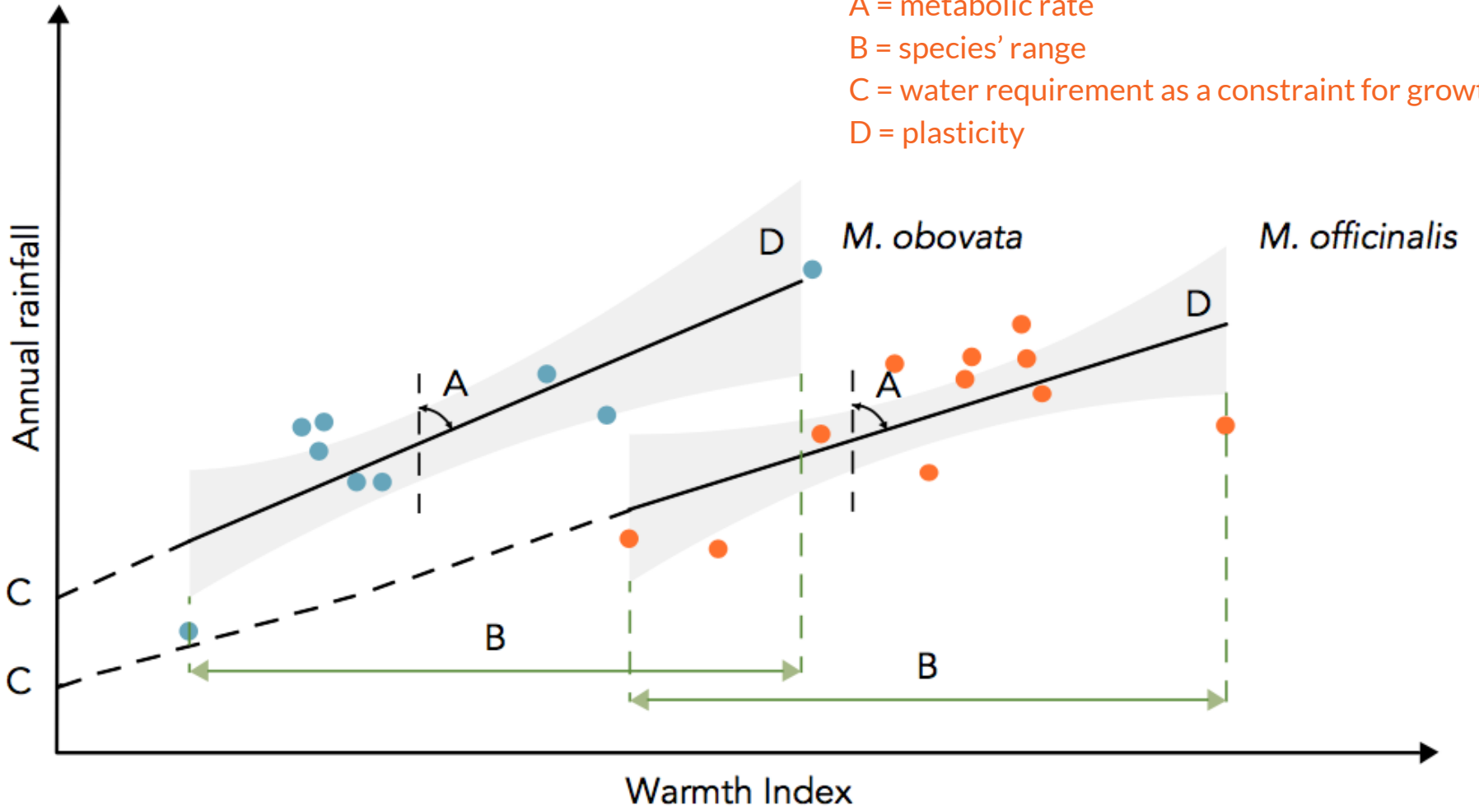

Magnolia sargentiana
Annual rainfall (mm)
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
Warmth Index


Magnolia virginiana
Annual rainfall (mm)
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
Warmth Index


Magnolia obovata
Annual rainfall (mm)
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
Warmth Index


Magnolia officinalis
Annual rainfall (mm)
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250
Warmth Index

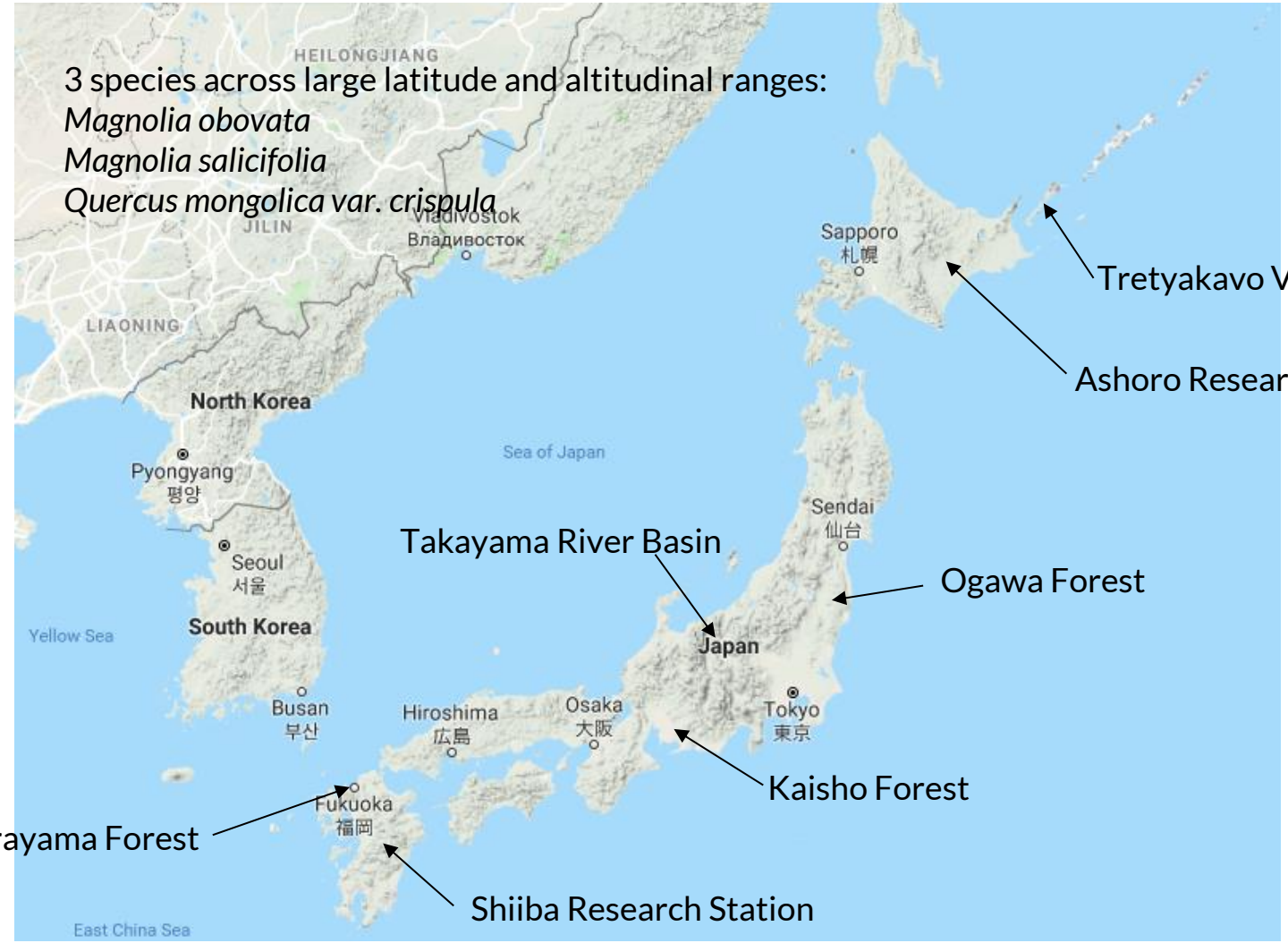
A = metabolic rate
B = species' range
C = water requirement as a constraint for growth
D = plasticity



But what if genetics leave something in the tank?

Plant hunting with a purpose

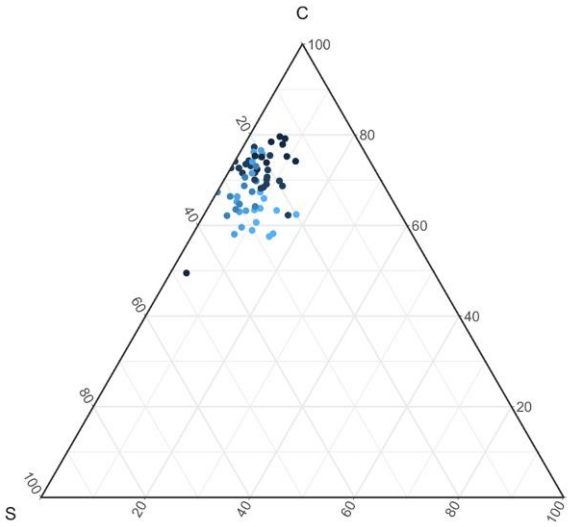
- Fieldwork allows us to undertake detailed habitat analysis,
- We can study the physiology of plants in the wild, looking at how they allocate resources, and
- Investigate the ways they respond to stress and disturbance


3 species across large latitude and altitudinal ranges:
Magnolia obovata
Magnolia salicifolia
Quercus mongolica var. crispula
HEILONGJIANG
JILIN
LIAONING
Vladivostok
Владивосток
Sapporo
札幌
Tretyakavo Valley
Ashoro Research Station
North Korea
Pyongyang
평양
Sea of Japan
Sendai
仙台
Takayama River Basin
Ogawa Forest
Seoul
서울
South Korea
Yellow Sea
Japan
Busan
부산
Hiroshima
広島
Osaka
大阪
Tokyo
東京
Kaisho Forest
Fukuoka
福岡
Aburayama Forest
Shiiba Research Station
East China Sea

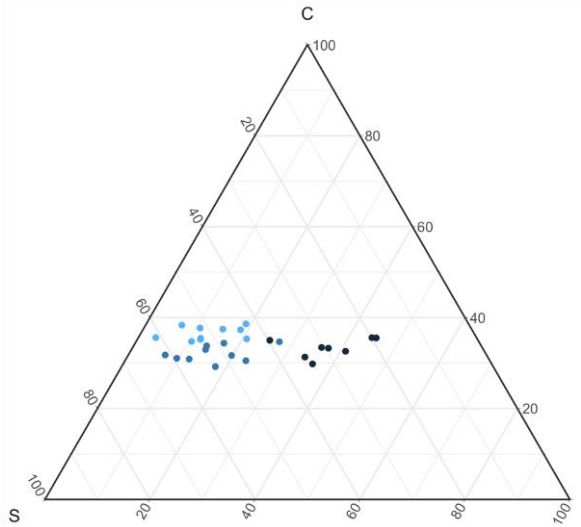
Seven species native to NW Europe:
Alnus glutinosa
Betula pendula
Crataegus monogyna
Populus tremula
Prunus avium
Quercus robur
Salix alba

Four species native to New Zealand:
Nothofagus fusca
Nothofagus menziesii
Nothofagus solandri
Nothofagus truncata

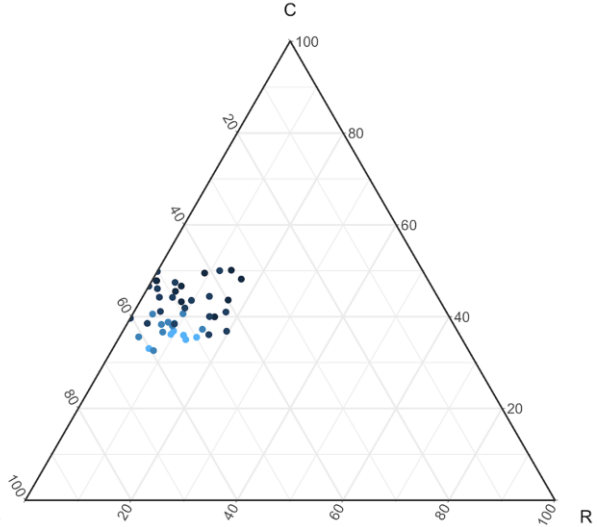
(From Richardson et al, 2015)



Magnolia obovata

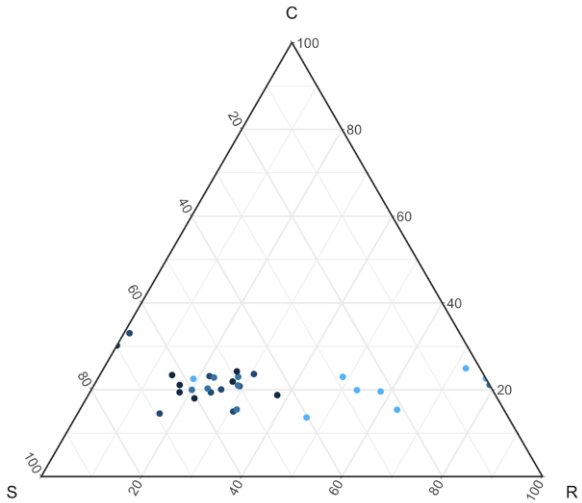


Magnolia salicifolia

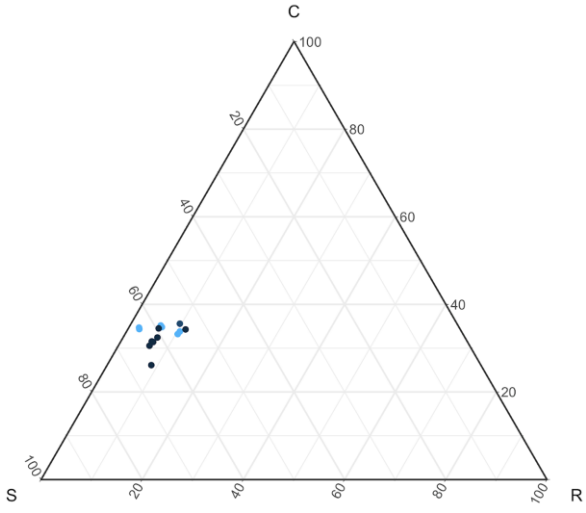


Quercus mongolica var. crispula

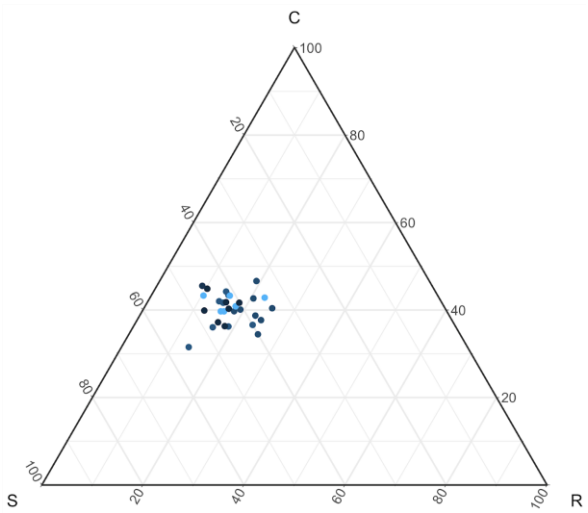
CSR ordinations of trees in Japan and the Russian Far East



Crataegus monogyna

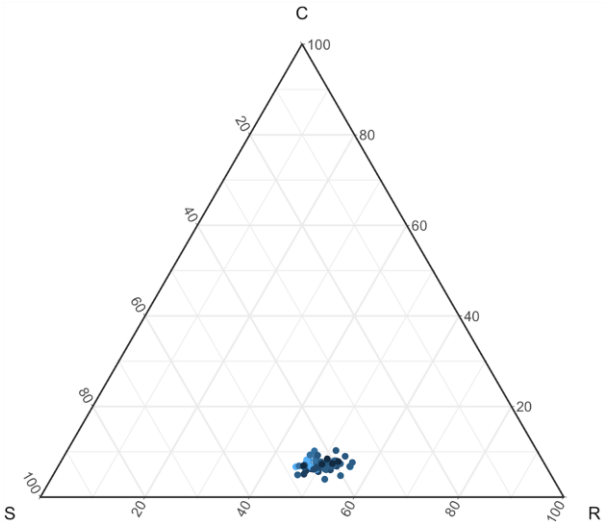


Populus tremula

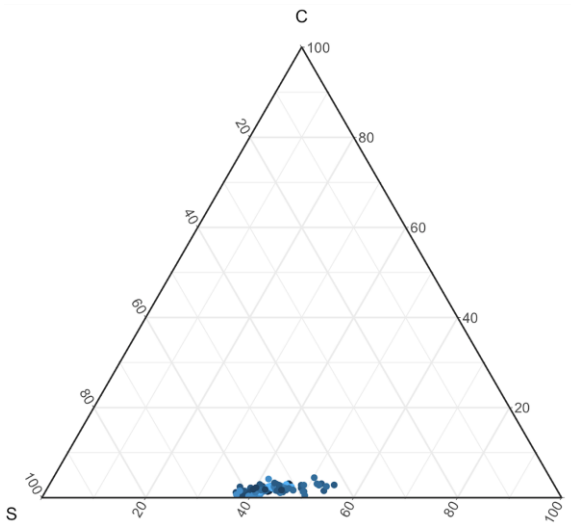


Prunus avium

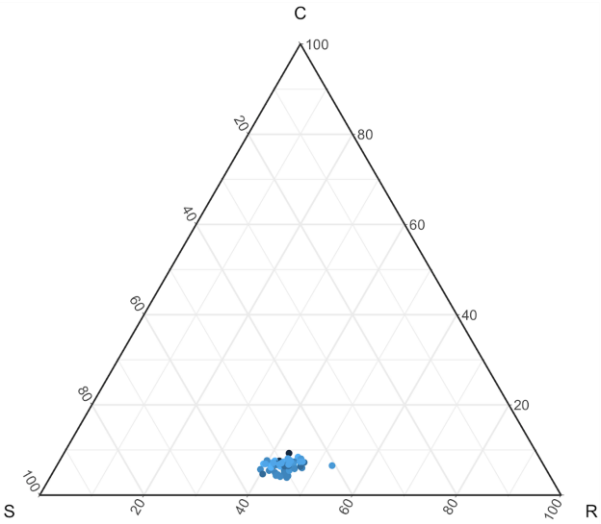
CSR ordinations of trees native to NW Europe



Nothofagus fusca



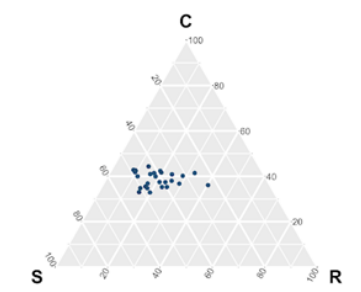
Nothofagus solandri



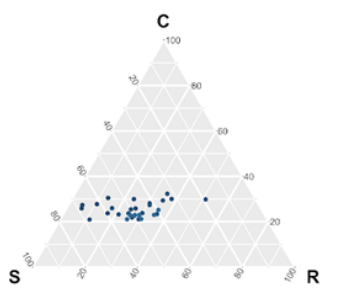
Nothofagus truncata

CSR ordinations of four Nothofagus species native to New Zealand

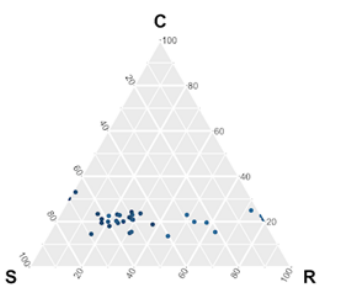
Alnus glutinosa



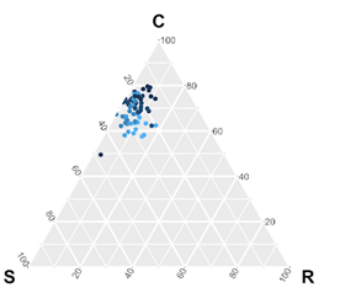
Betula pendula



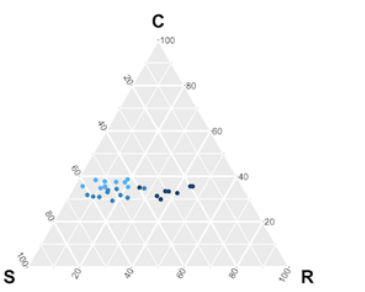
Crataegus monogyna



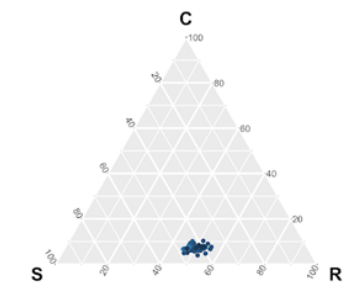
Magnolia obovata



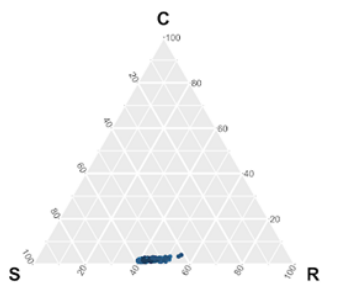
Magnolia salicifolia



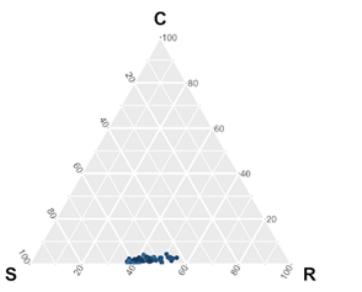
Nothofagus fusca



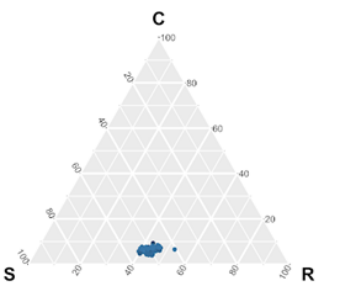
Nothofagus menziesii



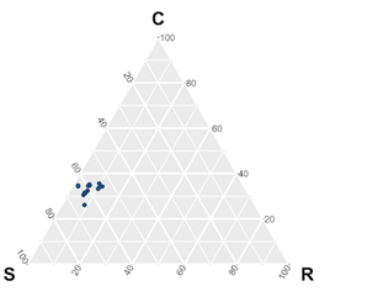
Nothofagus solandri



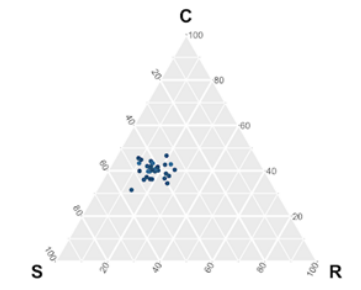
Nothofagus truncata



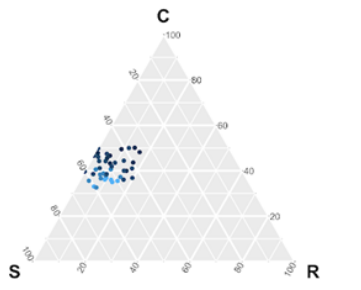
Populus tremula



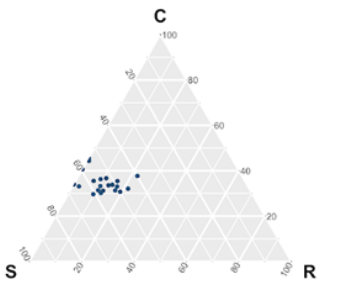
Prunus avium



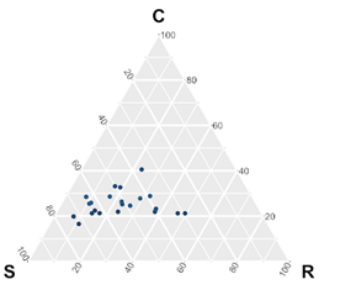
Quercus mongolica var. crispula



Quercus robur



Salix alba



Key findings

1. Genus Magnolia is more varied than we thought

Key findings

1. Genus Magnolia is more varied than we thought
2. Magnolia species are more varied than we thought

Key findings

1. Genus Magnolia is more varied than we thought
2. Magnolia species are more varied than we thought
3. It is likely that there are genotypes that are well adapted to tough urban conditions under climate breakdown

Is the species still a useful concept?

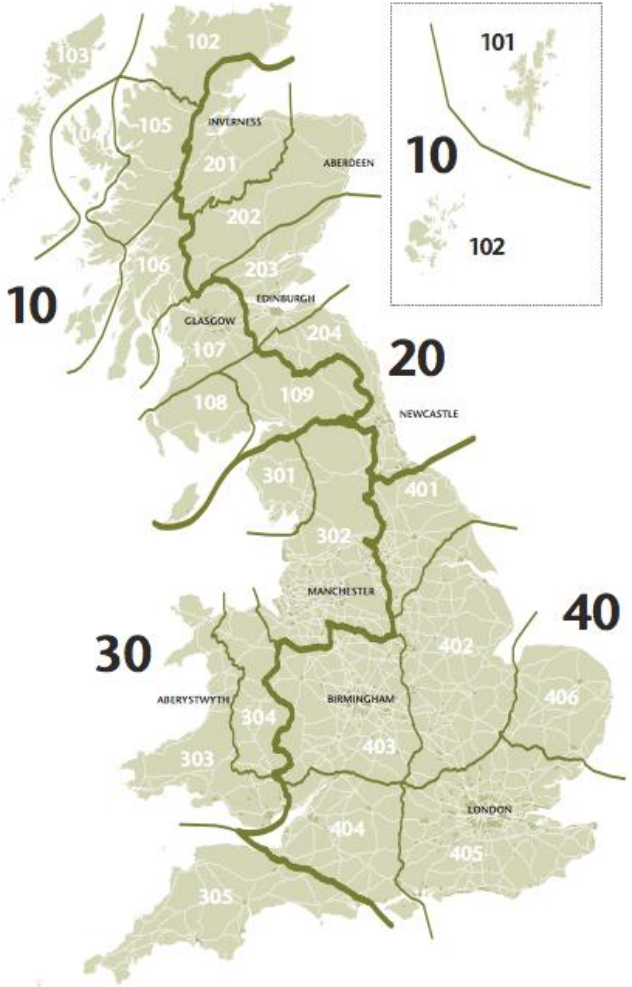
There are no guarantees - we can only stack the dice in our favour

Next steps - bridging the gaps between research, horticulture and specification

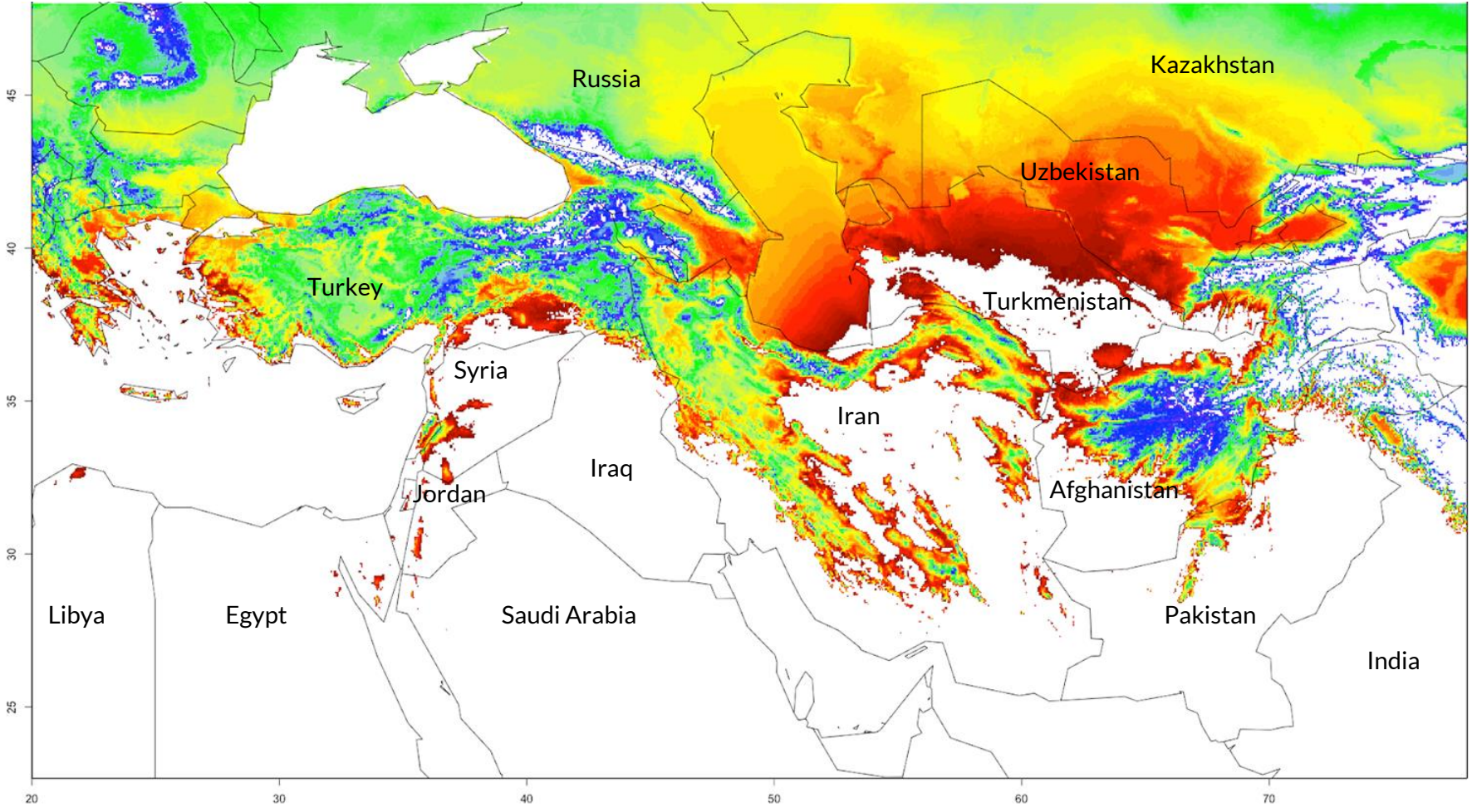
Rethink provenance

Lots of current guidance encourages us to specify trees from ~5-7º latitudes further south.

What does this mean for provenances in Chile or New Zealand?



Locations in SW Asia with warmth index similar to NW Europe under climate breakdown



Survey of landscape architects and biosecurity, February 2018

56% take “little or no interest in biosecurity news”

Yet 85% of respondents said they understood the issues and 81% reported that planting design was part of their job role

Only 7% of projects are carried out as specified

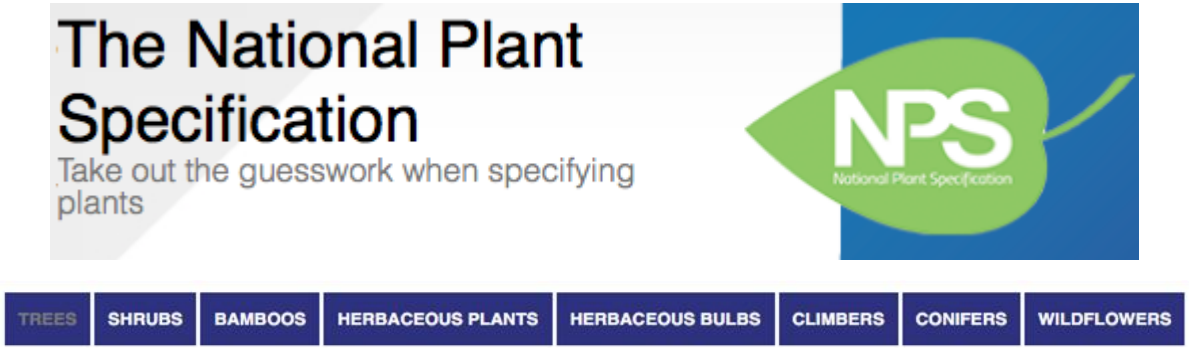
And landscape architects tend to be excluded from the process of managing substitutions or variations to contract

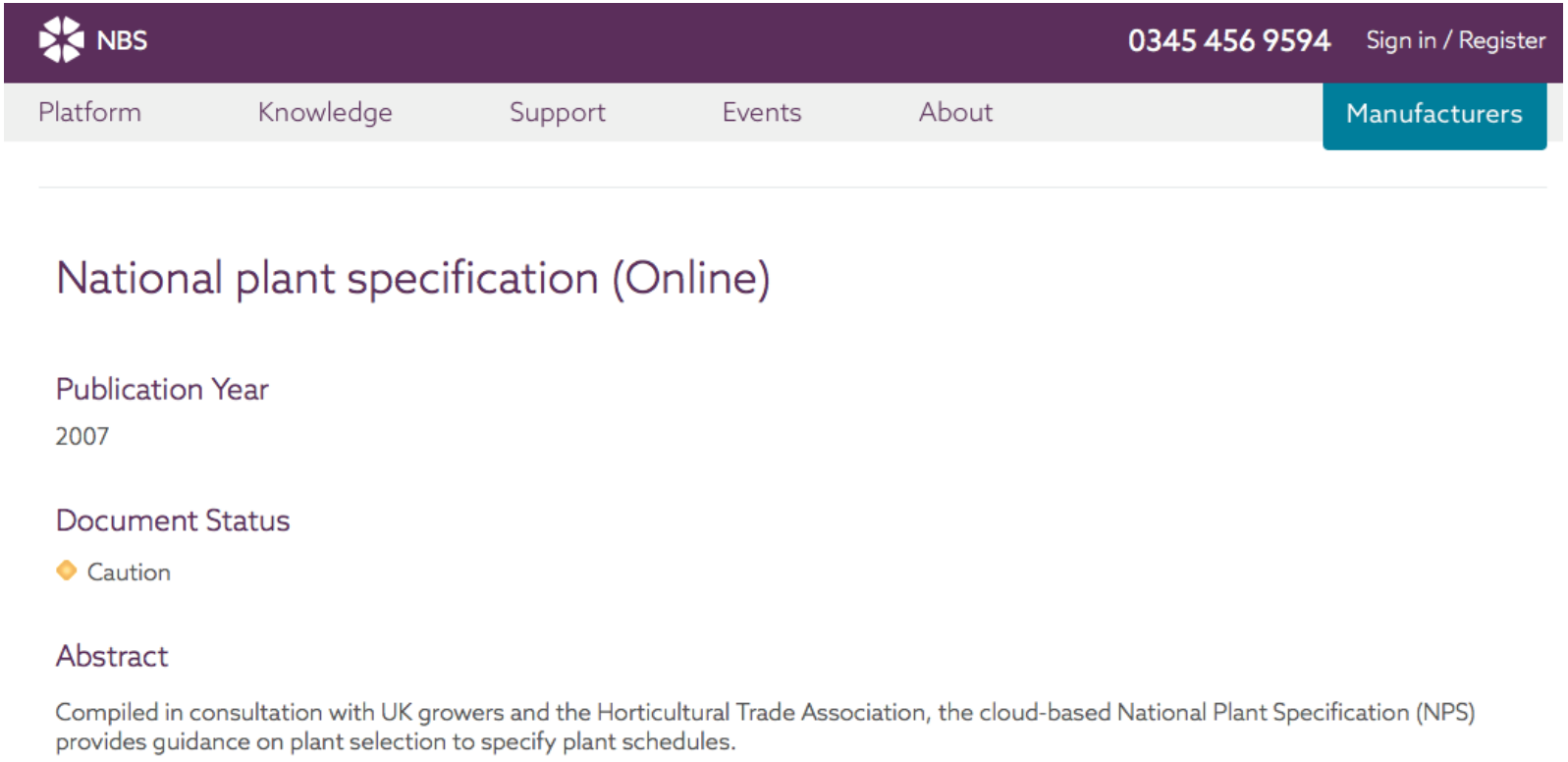
Only half of projects are visited by the consultant following completion

Landscape Institute Plant Health and Biosecurity Group, 2018

Our specification resources need to be overhauled

- The National Plant Specification is the industry standard resource, approved by the Landscape Institute, The Horticultural Trades Association and a private company
- It is out of date, awkward to use and expensive
- It doesn't actually help us specify plants based on where they will succeed in designed environments





https://www.thenbs.com/PublicationIndex/documents

Criteria for a plant thesaurus that we can all use

1. Tells us where and when plants are optimised… and when they die
2. Recognises provenance & intra-specific variation
3. Works with BIM
4. Is recognised and used by all horticulture & landscape sectors
5. Provides biosecurity and ecosystem service information
6. Limited palette (500 plants?), giving security across the supply chain