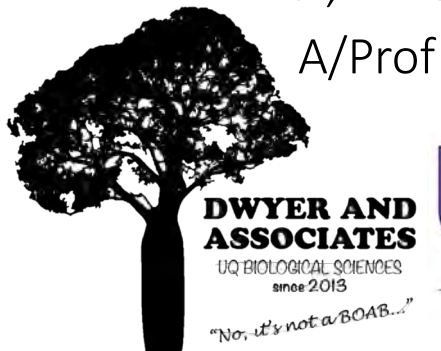
How are Australia's subtropical rainforest communities structured by climate?

Julian Radford-Smith,
Dr H. R. Lai, E. Cathcart-van Weeren &
A/Prof John Dwyer



THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

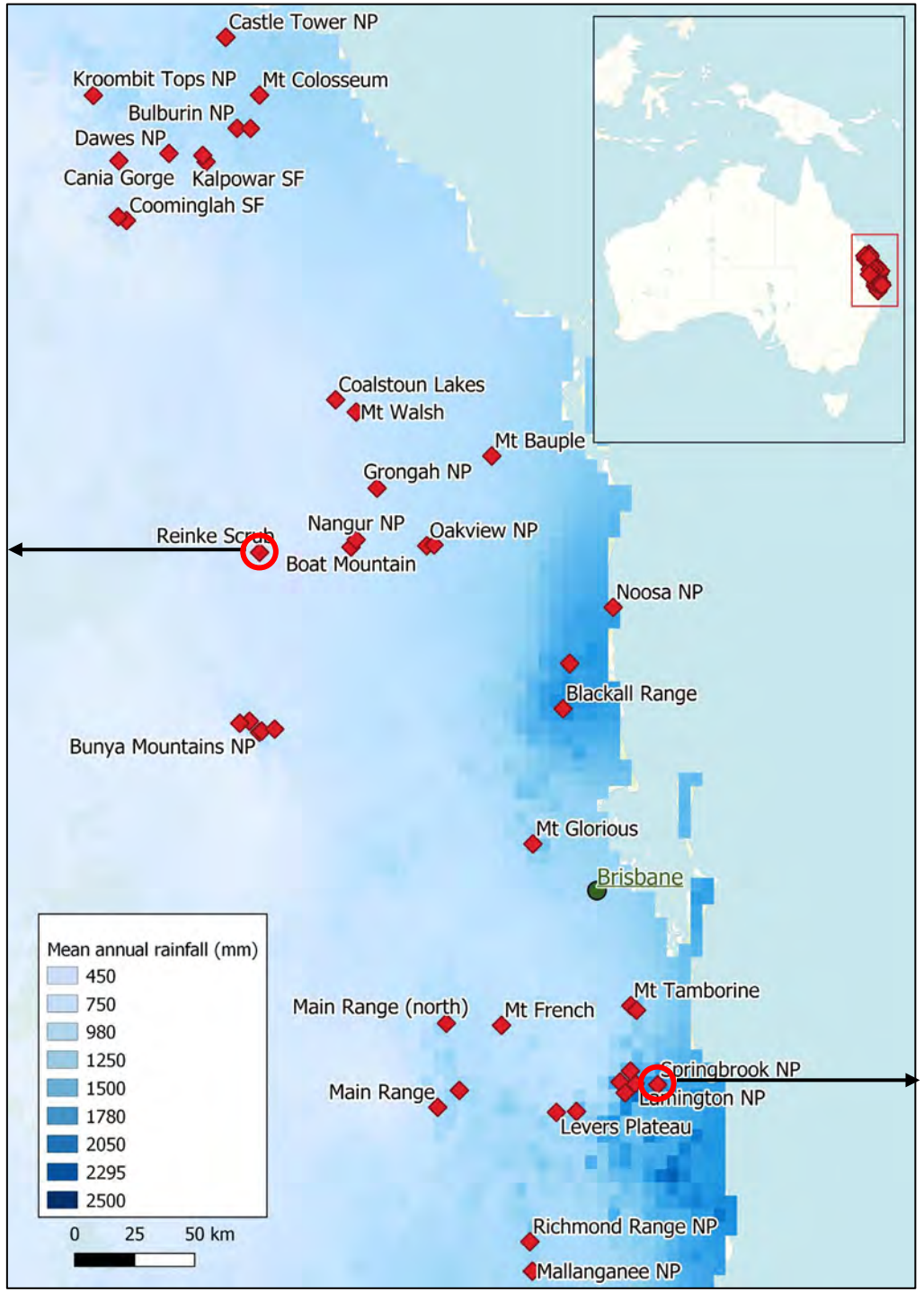
CREATE CHANGE

Regional moisture gradient

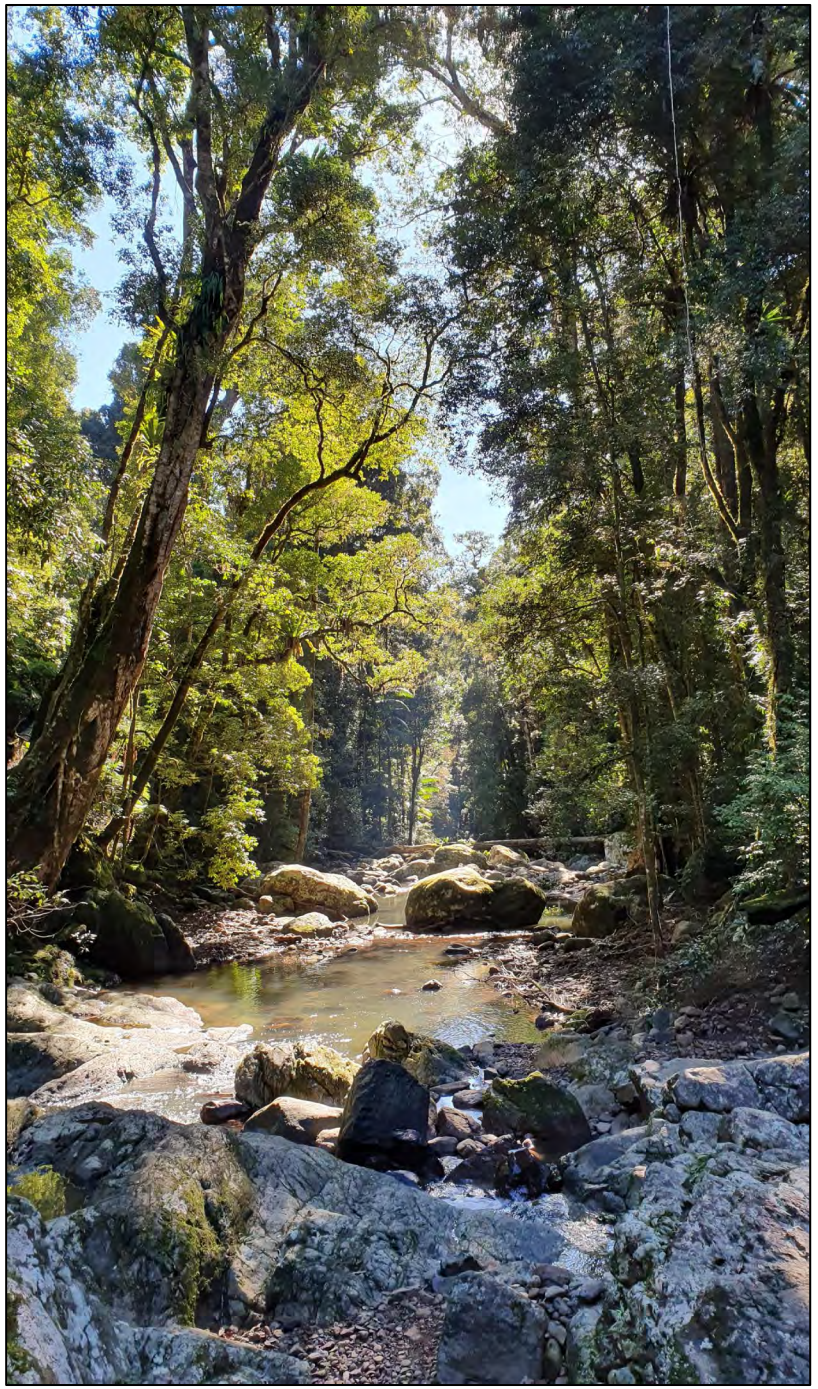
Low moisture
600 mm/year

High moisture
2,500 mm/year

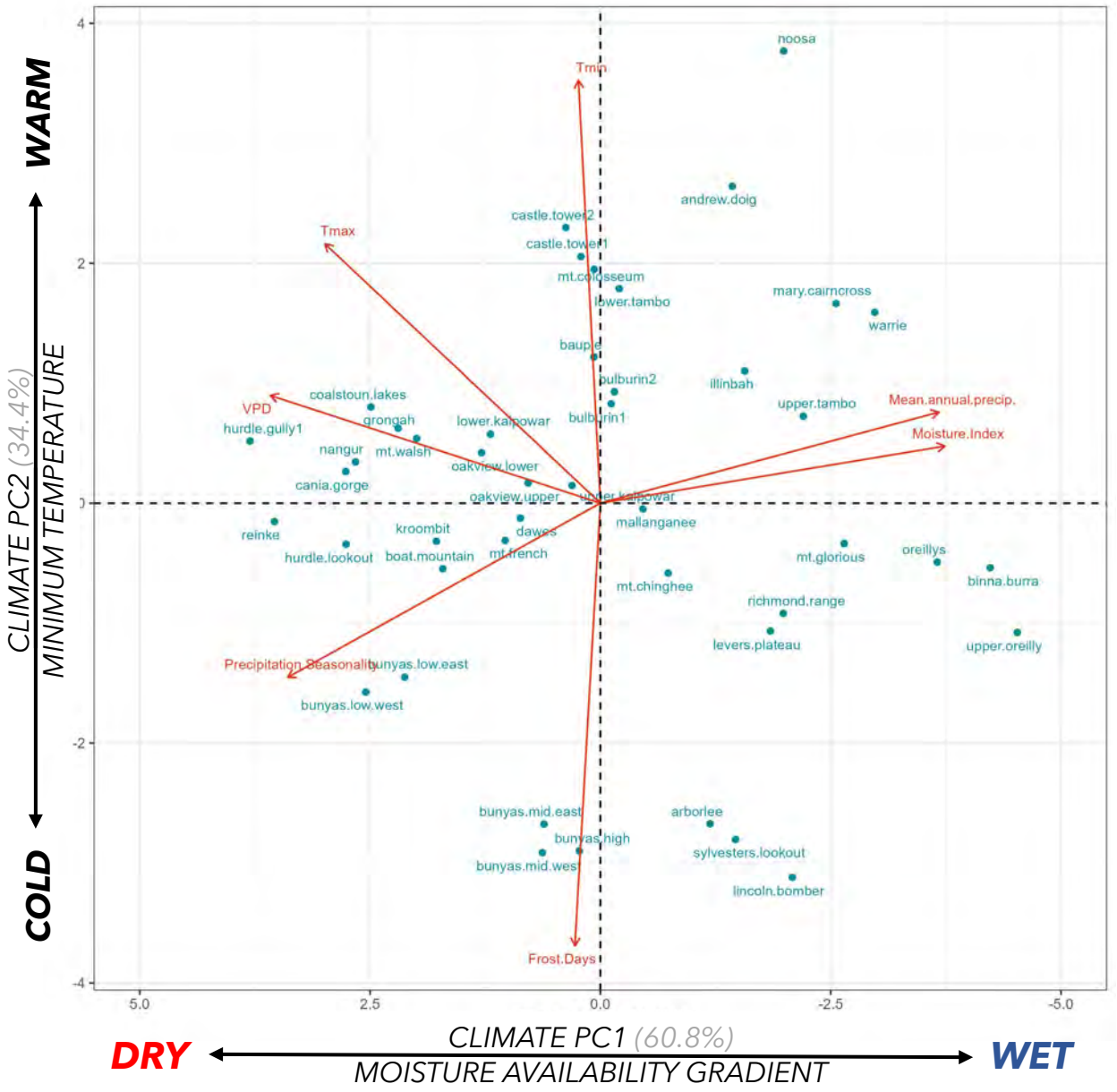
How does climate filter subtropical rainforest tree strategies into these distinct assemblages?


Castle Tower NP
Kroombit Tops NP
Mt Colosseum
Bulburin NP
Dawes NP
Cania Gorge
Kalpowar SF
Coominglah SF
Coalstoun Lakes
Mt Walsh
Mt Bauple
Grongah NP
Nangur NP
Oakview NP
Reinke Scrub
Boat Mountain
Noosa NP
Blackall Range
Bunya Mountains NP
Mt Glorious
Brisbane
Mean annual rainfall (mm)
450
750
980
1250
1500
1780
2050
2295
2500
0
25
50 km
Main Range (north)
Mt French
Mt Tamborine
Springbrook NP
Main Range
Lamington NP
Levers Plateau
Richmond Range NP
Mallanganee NP

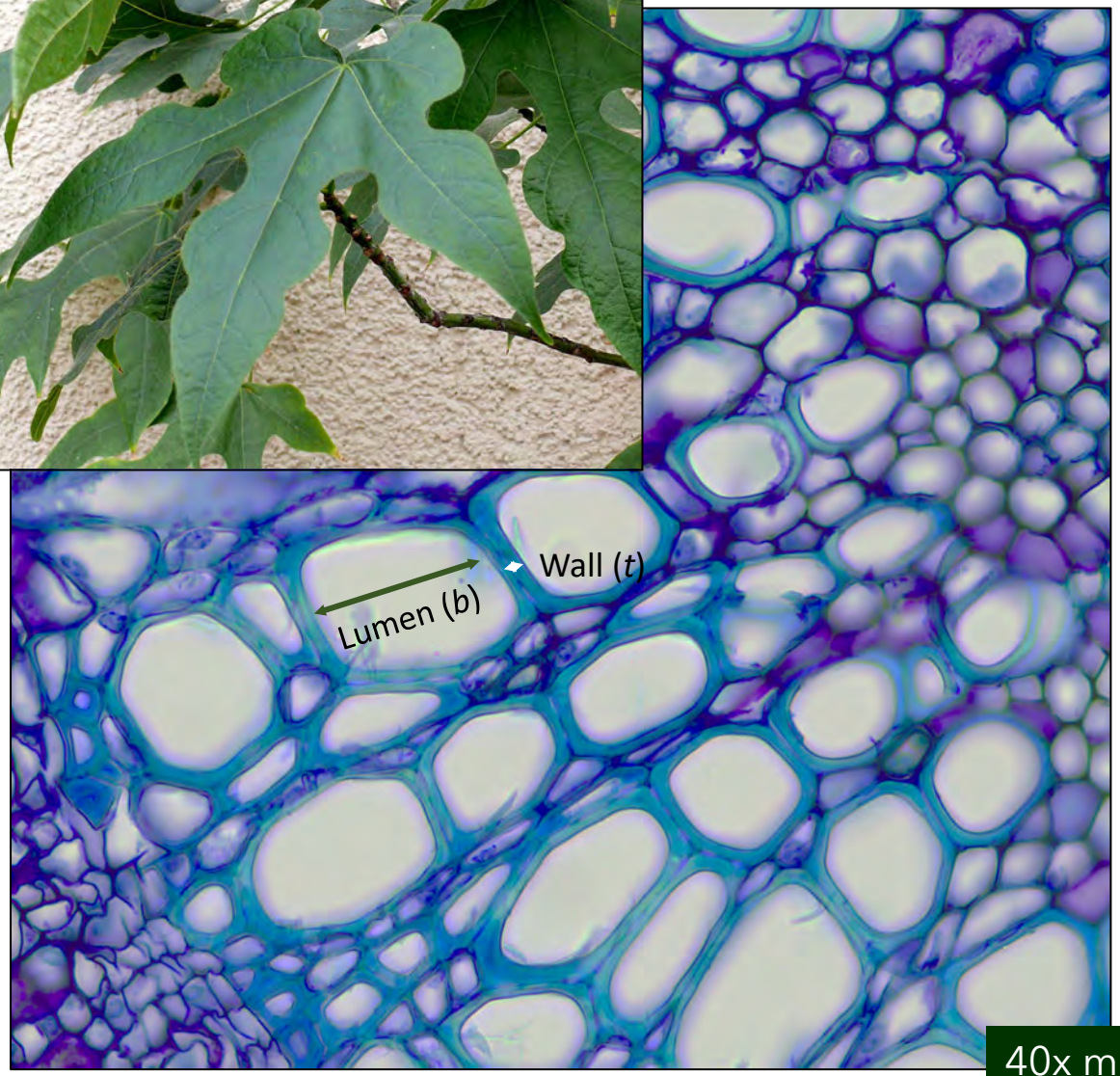

macpac



Describing the regional climate gradient

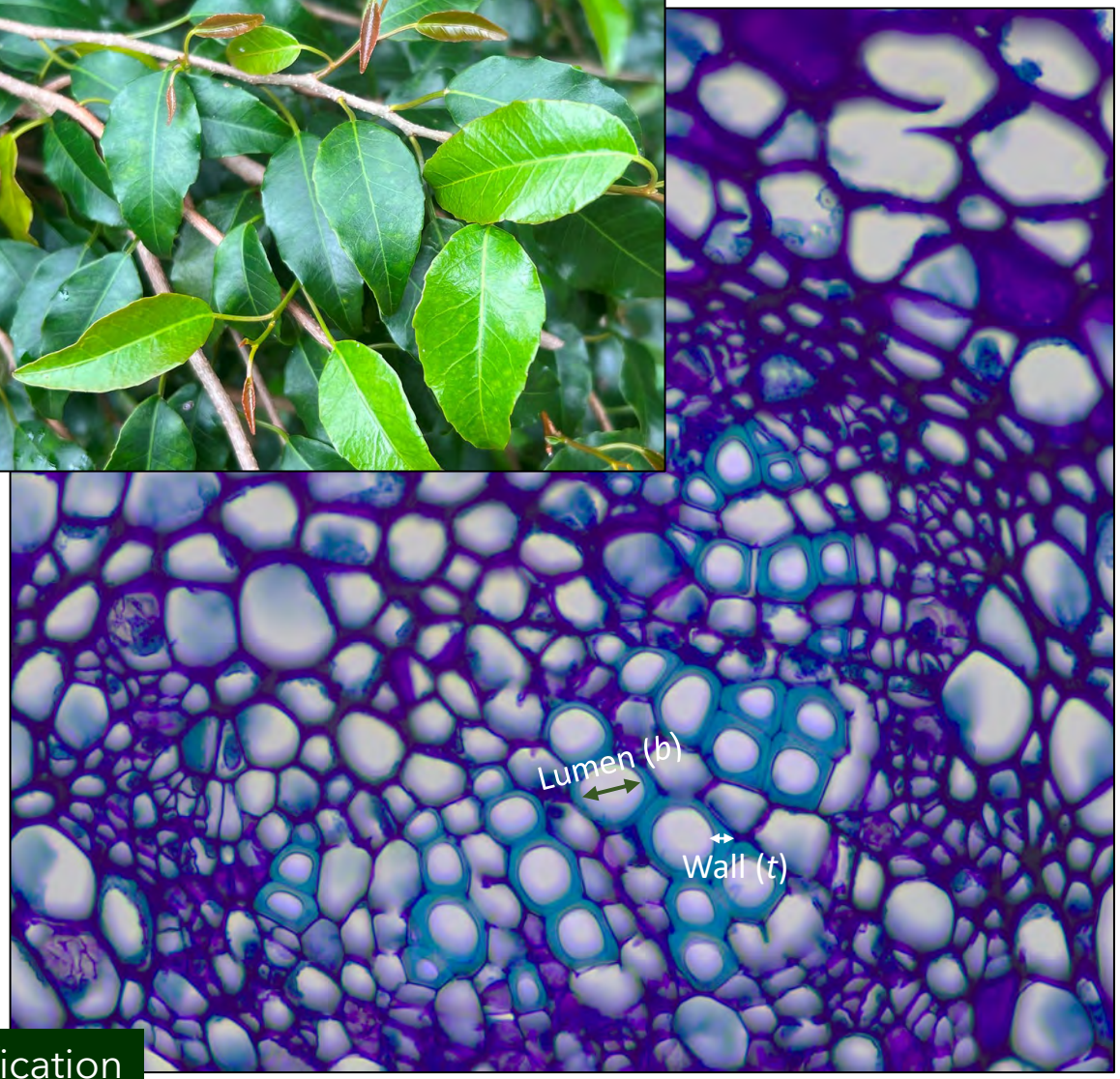


Describing hydraulic strategies of 285 species

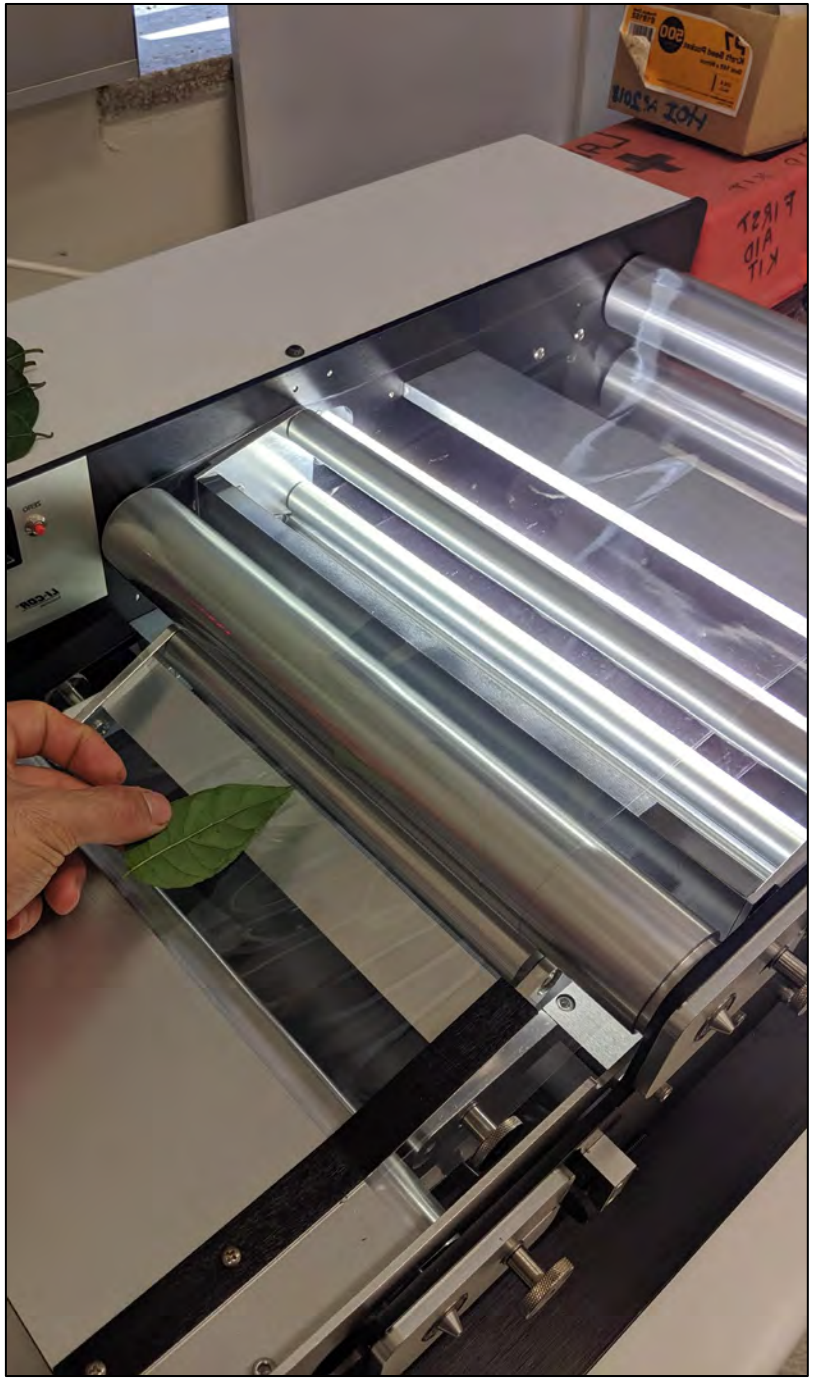


Brachychiton discolor

40x magnification

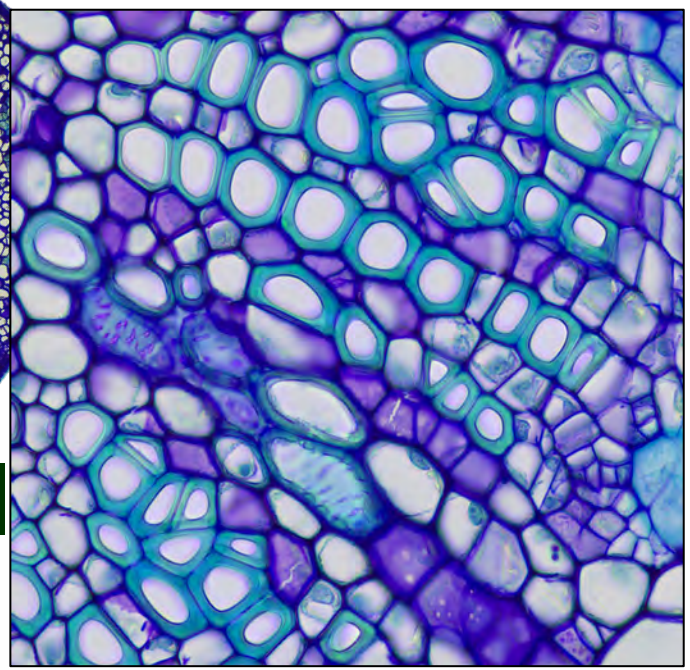


Excoecaria dallachyana



Leaf traits

Plant organ	Plant trait
Stem	Wood density
Whole plant	Maximum height
Leaves	Specific leaf area
	Leaf dry matter content
	Lamina area
	Xylem lumen breadth (b)
	Vessel reinforcement (t / b)
	Deciduousness



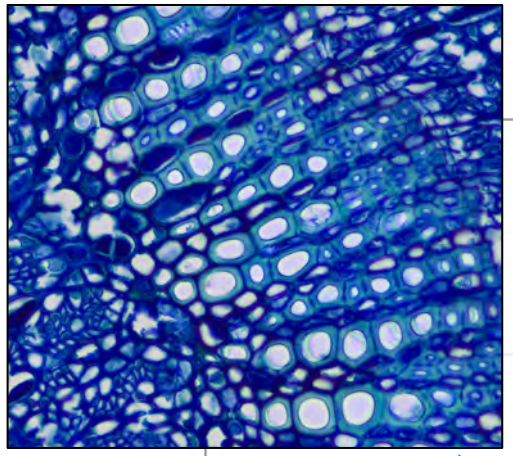
Xylem measurements

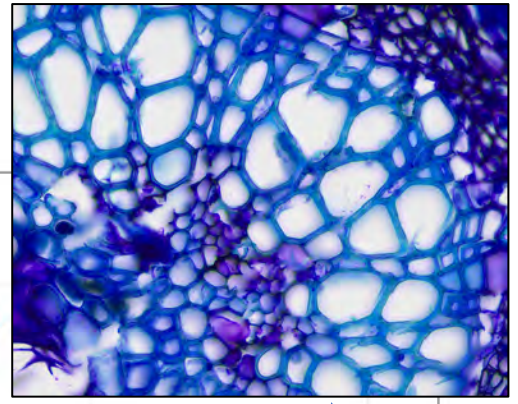
Wood density

Deciduousness

Max. height

Describing hydraulic strategies of 285 species





LDMC

Max height

Leaf area

Lumen breadth

Wood density

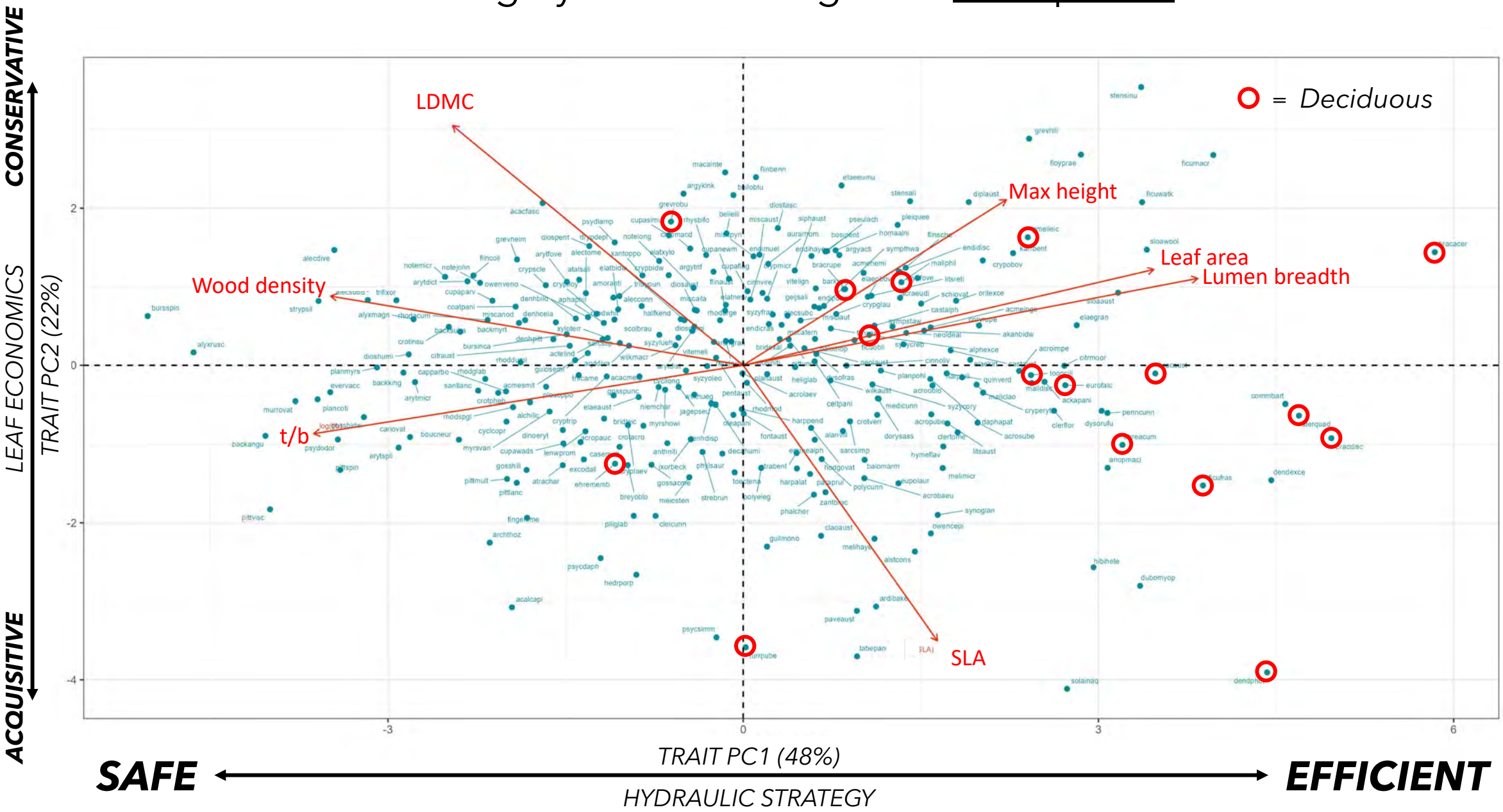
Vessel reinforcement

SLA

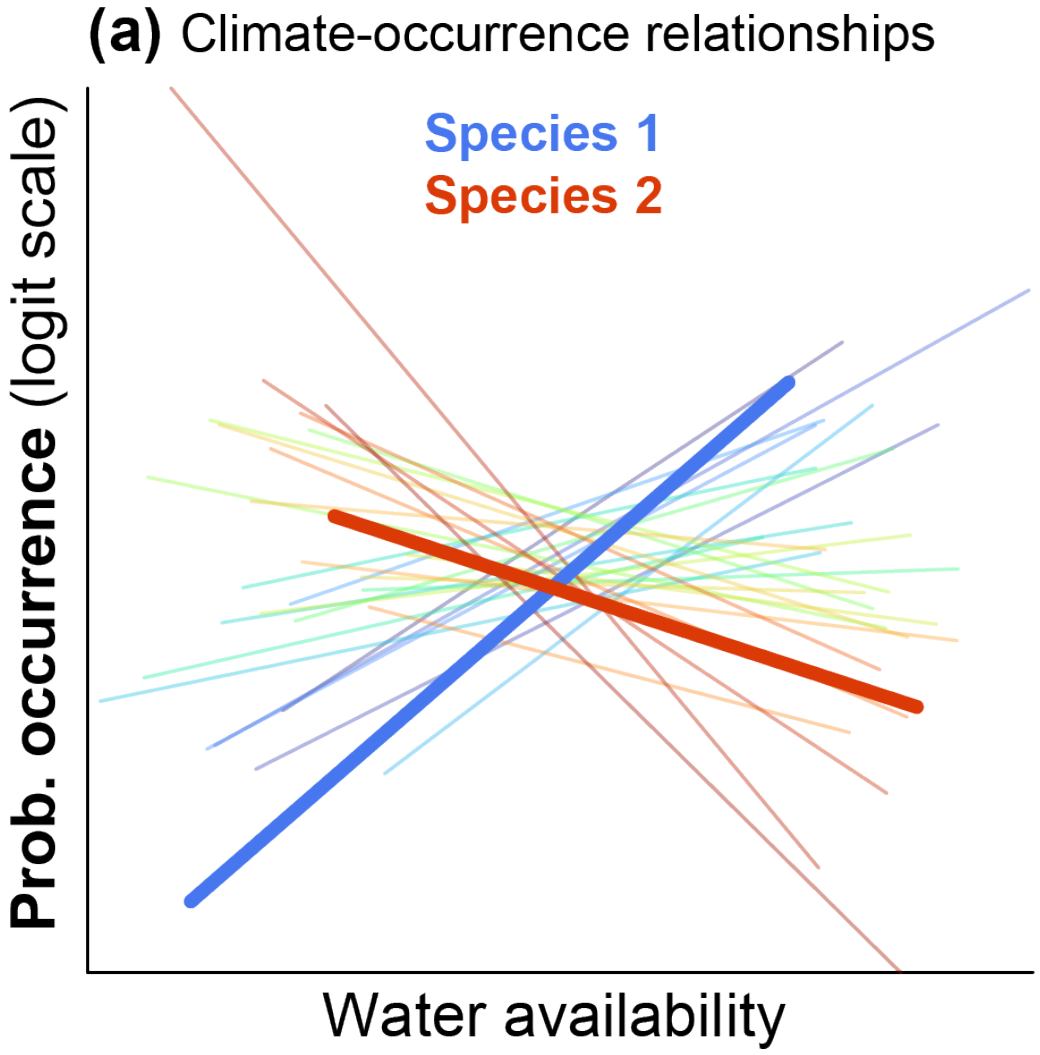
TRAIT PC2 (22%)

TRAIT PC1 (48%)

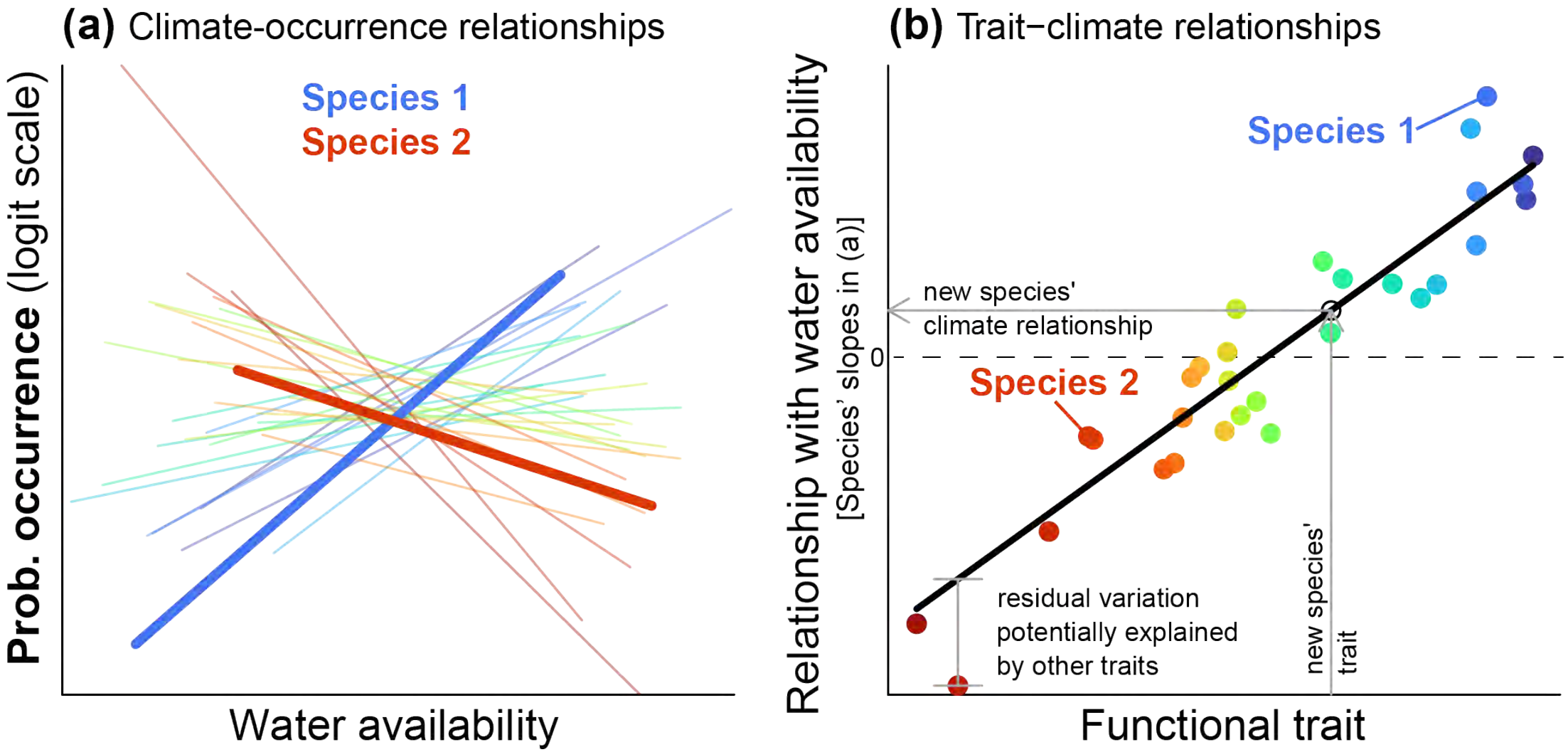
Describing hydraulic strategies of 285 species



Binomial GLLVM with **Trait*Climate interactions**

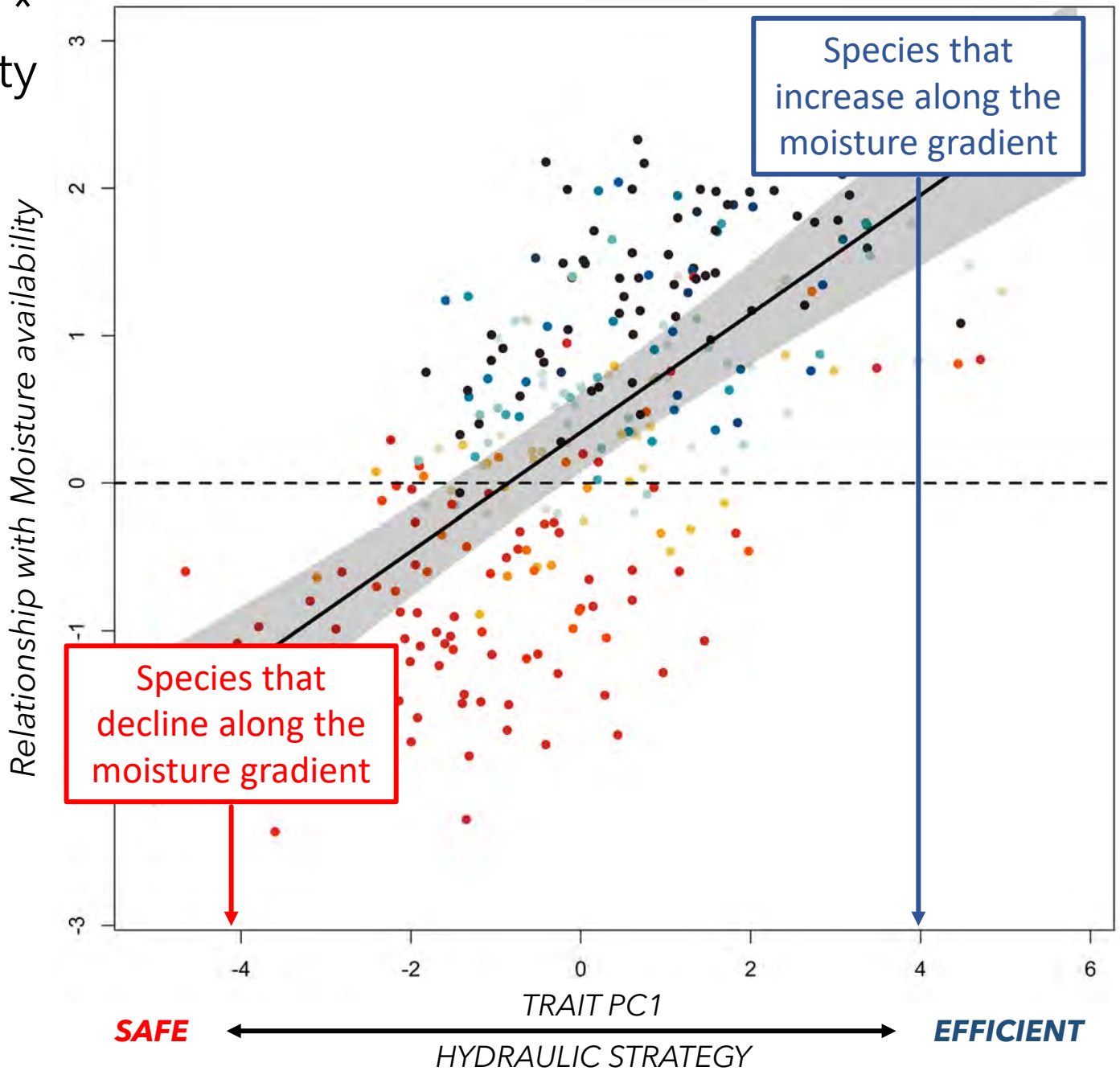


Binomial GLLVM with **Trait*Climate interactions**

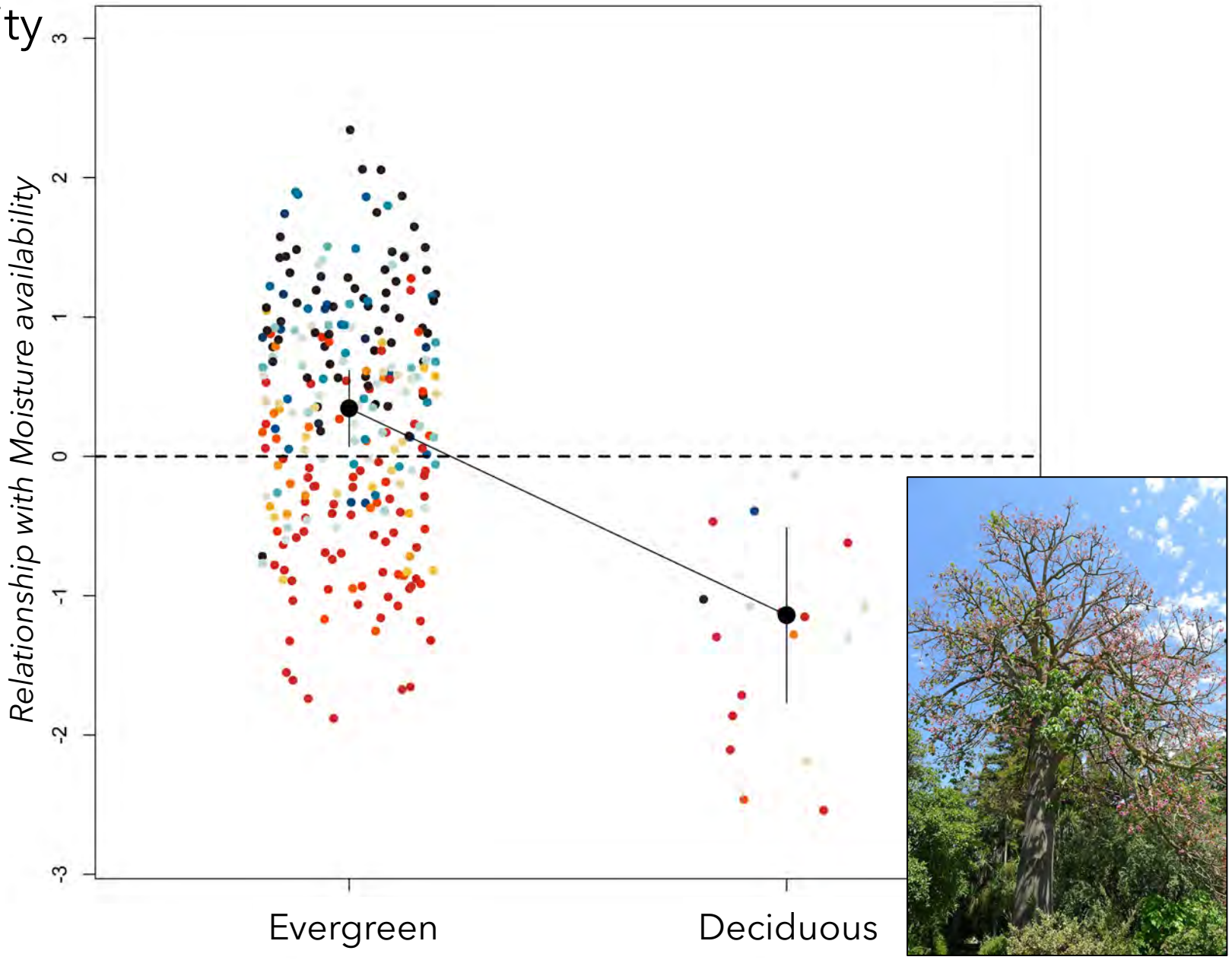


DRY
CLIMATE PC1
MOISTURE AVAILABILITY GRADIENT
WET

Hydraulic strategy * Moisture availability



Deciduous * Moisture availability



We reveal an ecophysiological basis for how climate structures entire rainforest tree communities across the Australian subtropics.

Low moisture → High moisture

Thank you!

Supervisor:

A/Prof John Dwyer

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Field assistance:

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Access:

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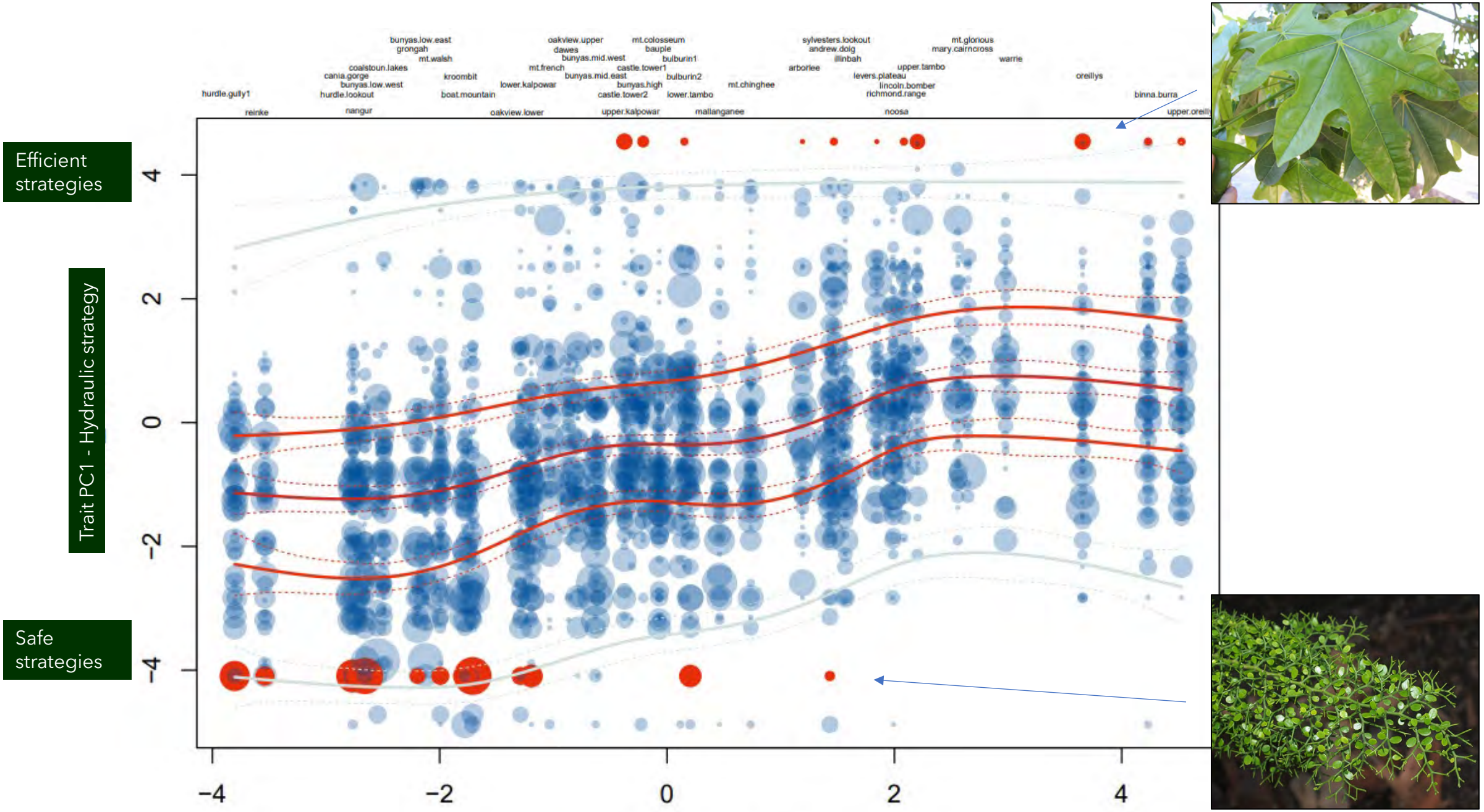
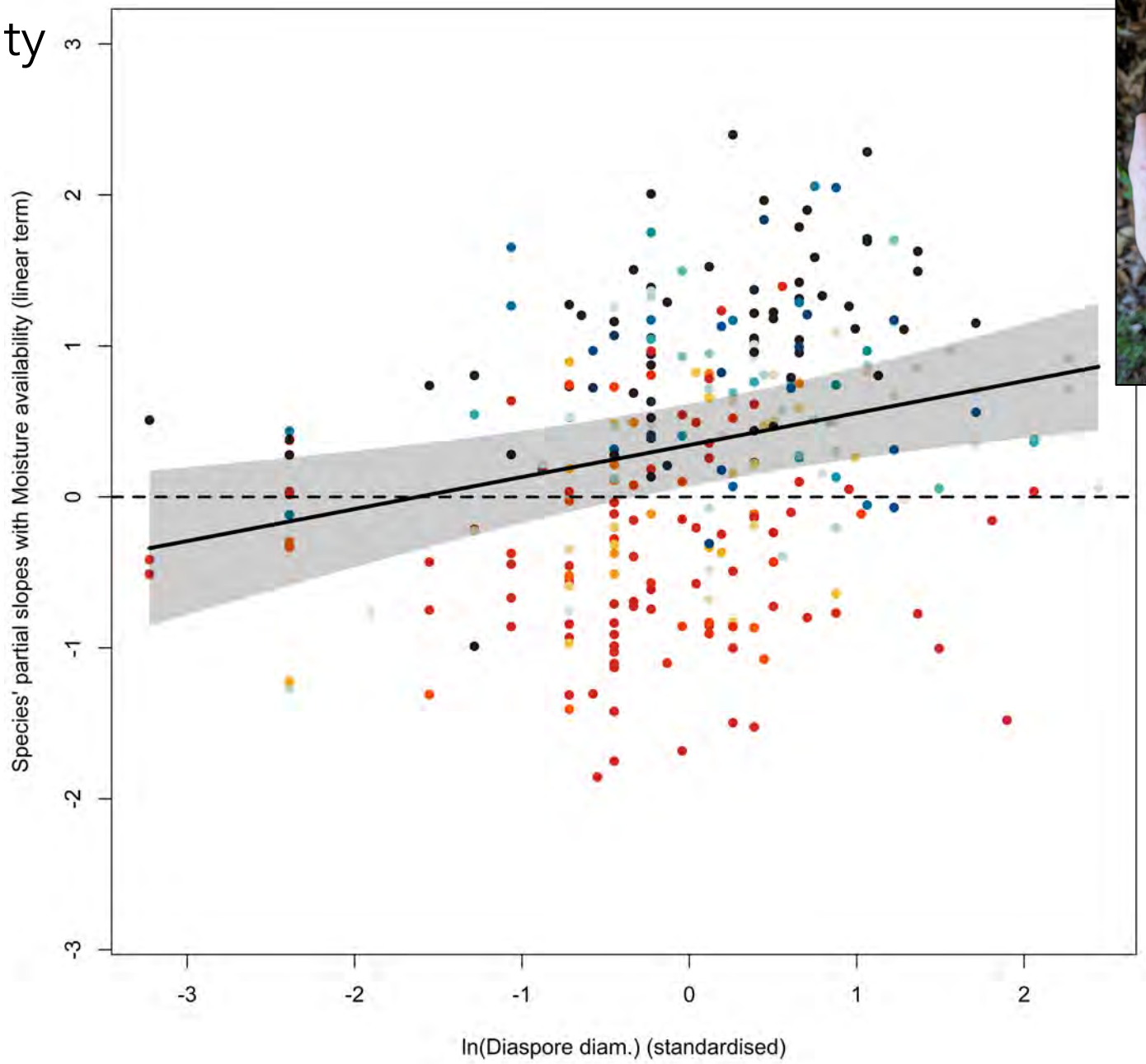
Advice:

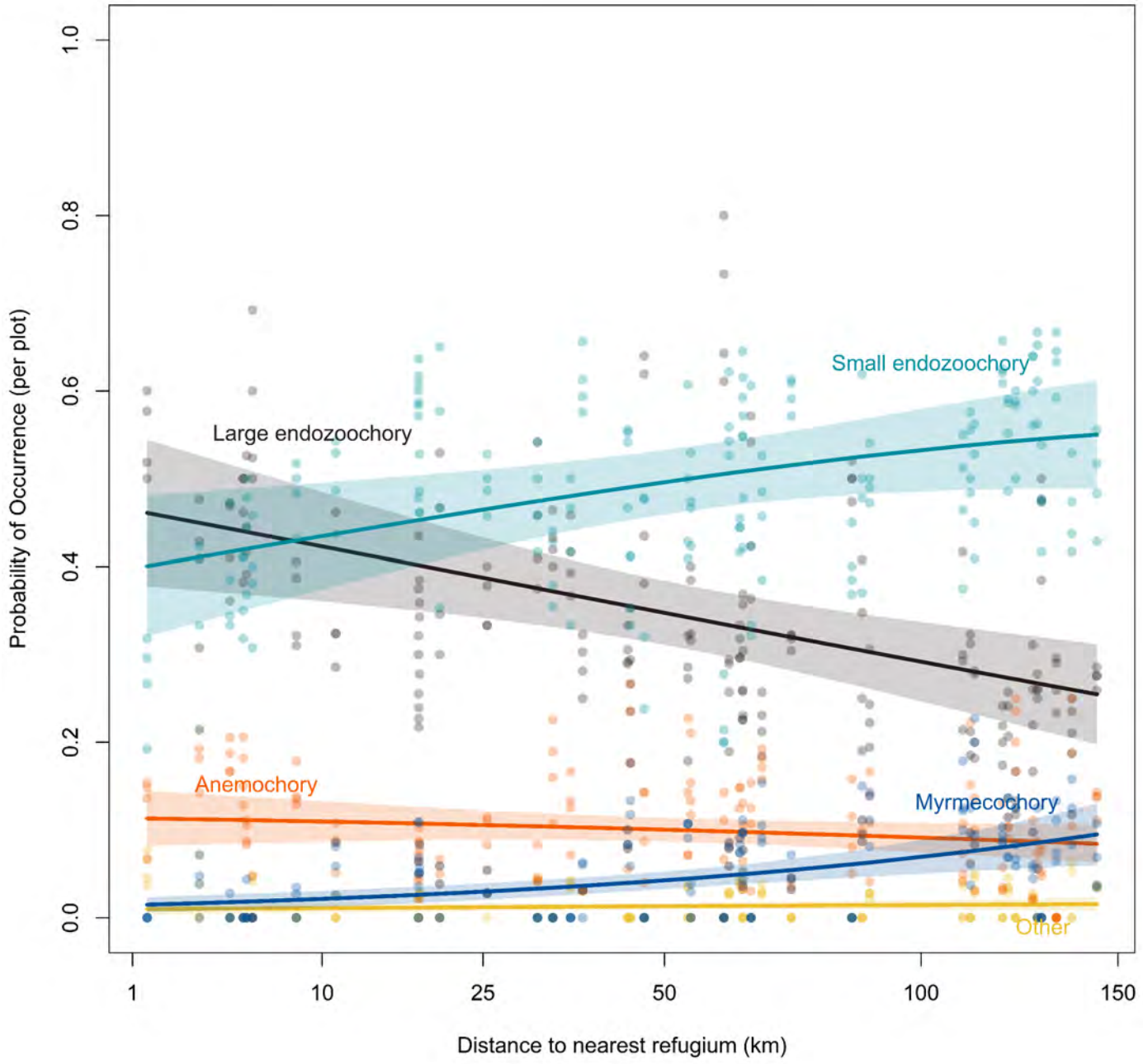
Renée Marchin, Bill McDonald, Spencer Shaw, Cath Moran, Rhonda Green, Martine Maron, Tim Brodribb, Mark Westoby, Paul Rymer, Dan Metcalfe, Dan Falster, Isaac Towers, Peter Vesk

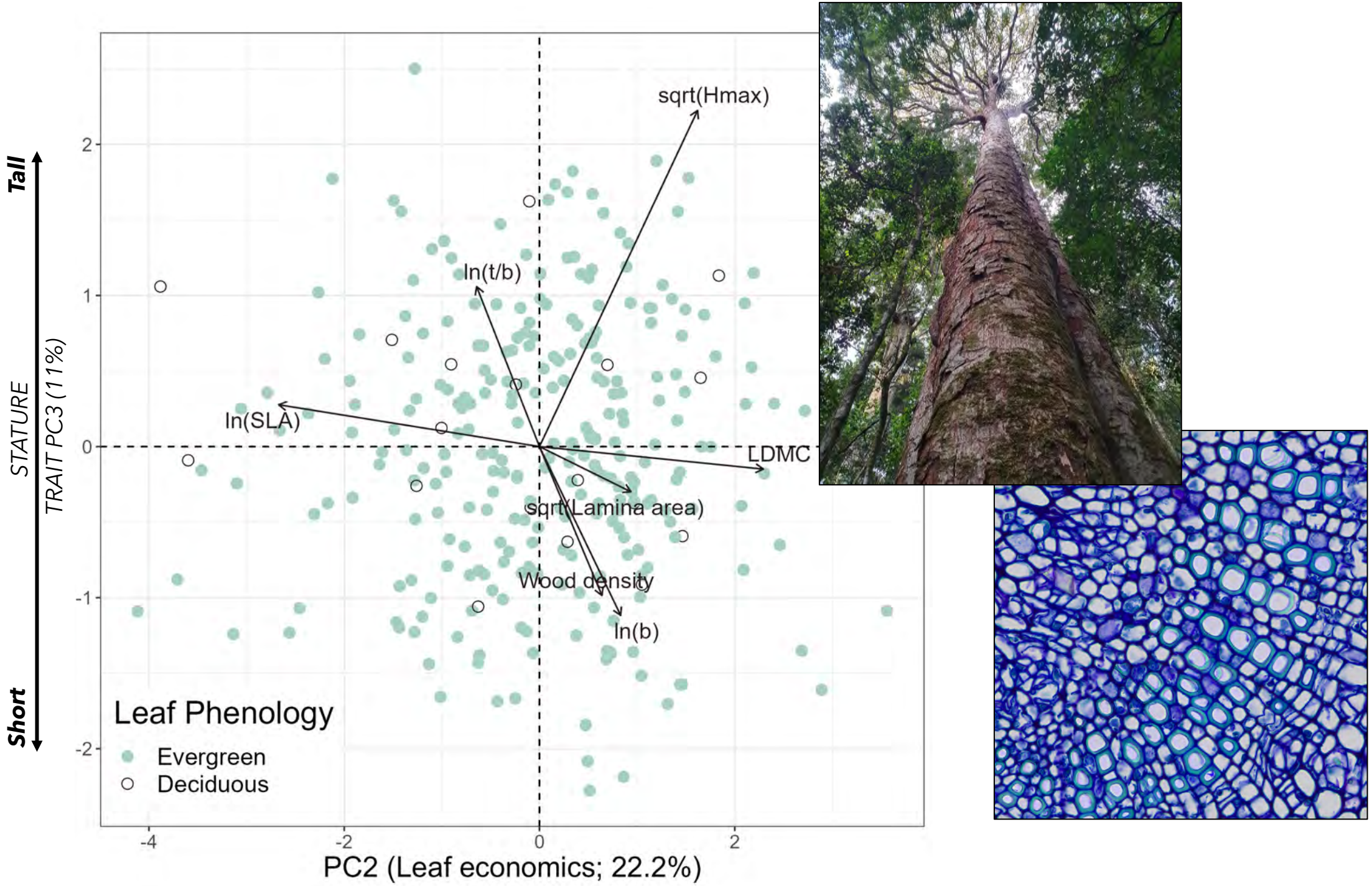

Efficient strategies
Safe strategies
Trait PC1 - Hydraulic strategy
4
2
0
−2
−4
bunyas.low.east
grongah
mt.walsh
coalstoun.lakes
cania.gorge
bunyas.low.west
hurdle.gully1
hurdle.lookout
kroombit
boat.mountain
reinke
nangur
oakview.upper
dawes
bunyas.mid.west
mt.french
bunyas.mid.east
lower.kalpowar
oakview.lower
mt.colosseum
bauple
bulburin1
castle.tower1
bulburin2
bunyas.high
castle.tower2
upper.kalpowar
lower.tambo
mallanganee
mt.chinghee
sylvesters.lookout
andrew.doig
illinbah
arborlee
levers.plateau
lincoln.bomber
richmond.range
noosa
mt.glorious
mary.cairncross
warrie
upper.tambo
oreillys
binna.burra
upper.oreilly
−4
−2
0
2
4
Low moisture availability
Climate PC1 – Moisture availability
High moisture availability

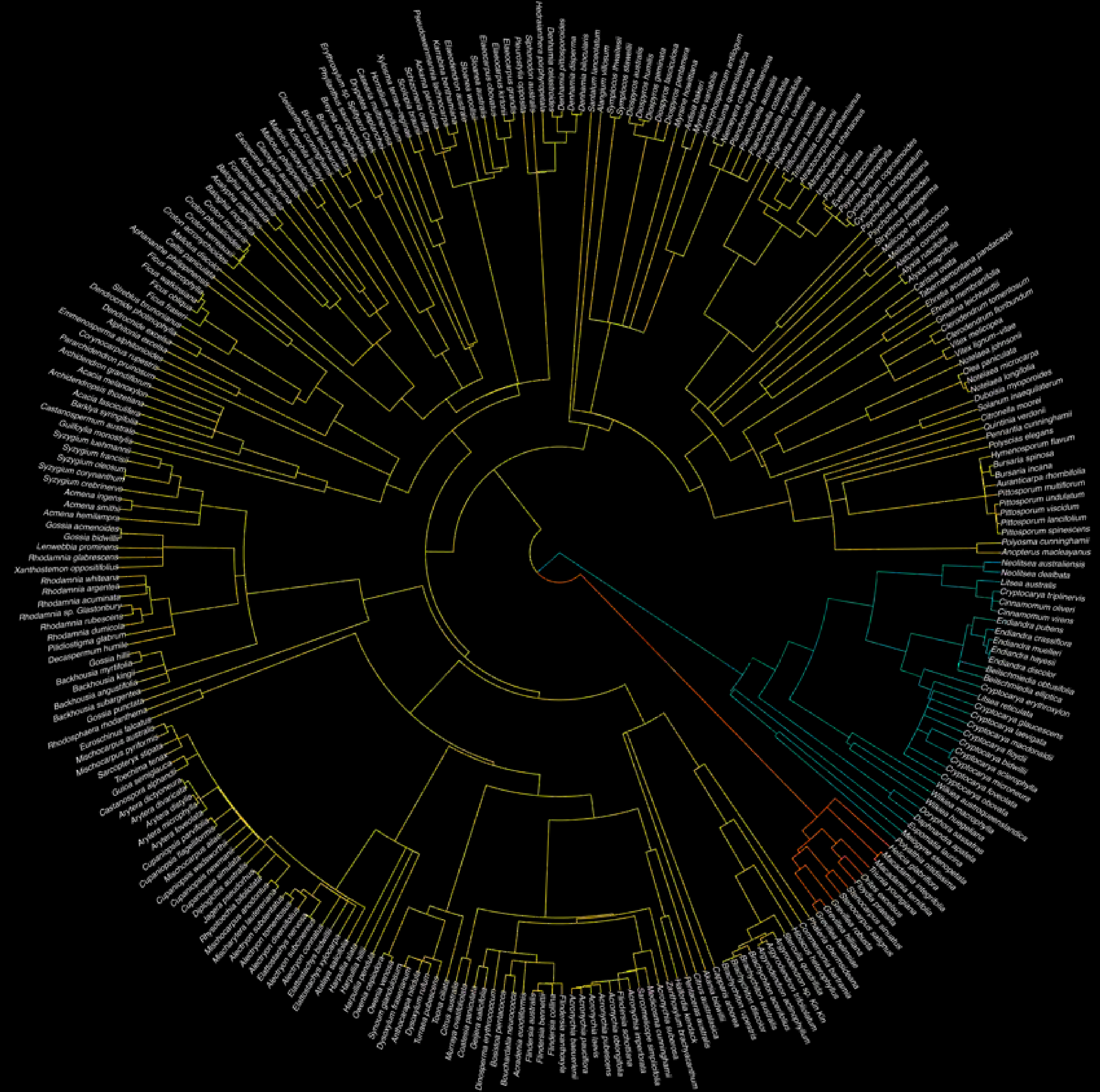
Diaspore diameter *
Moisture availability



Dispersal mode vs. Distance to nearest refugium




Tall
STATURE
TRAIT PC3 (11%)
Short
sqrt(Hmax)
ln(t/b)
ln(SLA)
LDMC
sqrt(Lamina area)
Wood density
ln(b)
Leaf Phenology
Evergreen
Deciduous
PC2 (Leaf economics; 22.2%)
2
1
0
-1
-2
-4
-2
0
2

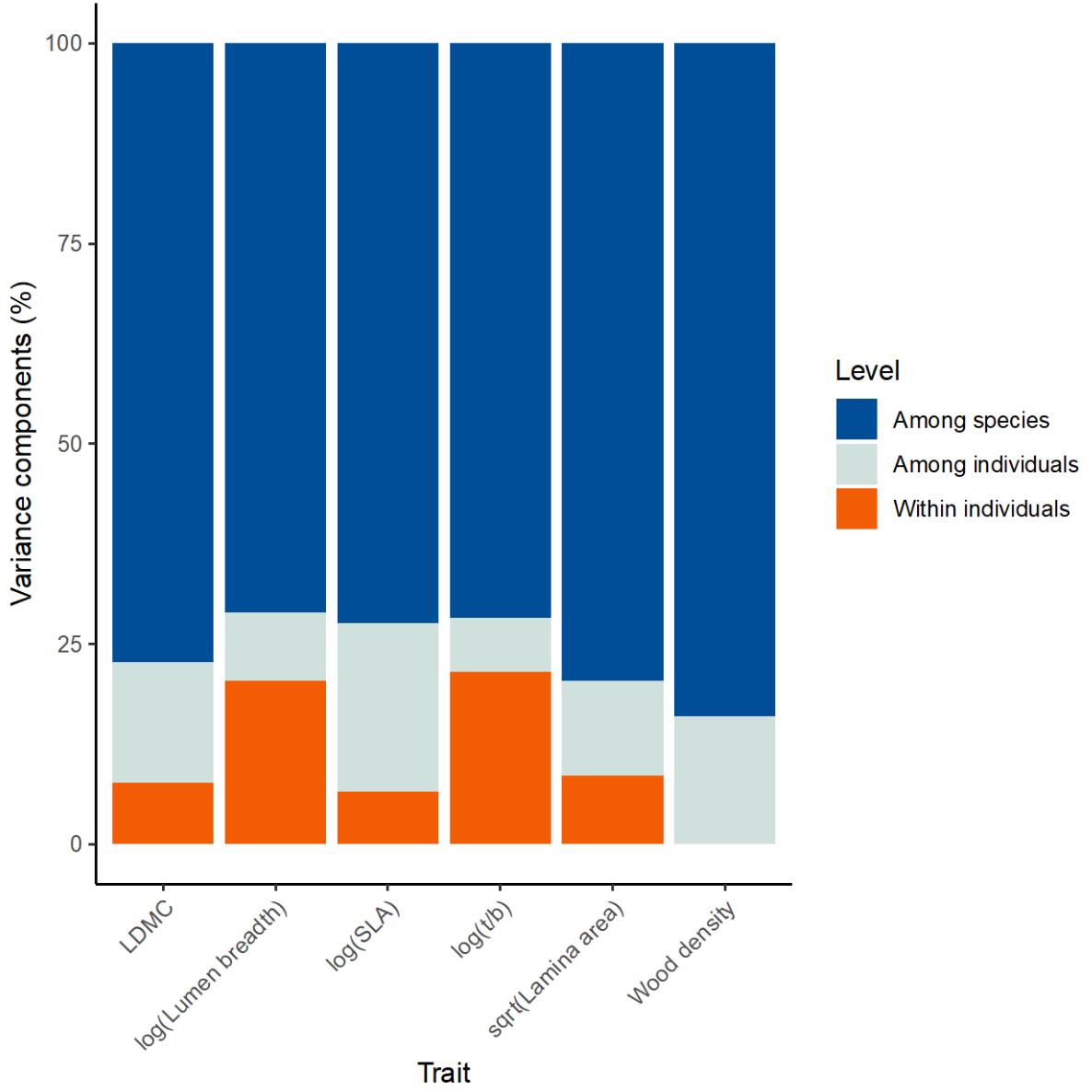


Polyosma cunninghamii
Anopterus macleayanus
Neolitsea australiensis
Neolitsea dealbata
Litsea australis
Cryptocarya triplinervis
Cinnamomum oliveri
Cinnamomum virens
Endiandra pubens
Endiandra crassiflora
Endiandra muelleri
Endiandra hayesii
Endiandra discolor
Beilschmiedia obtusifolia
Beilschmiedia elliptica
Cryptocarya erythroxylon
Litsea reticulata
Cryptocarya glaucescens
Pittosporum spinescens
Pittosporum lancifolium
Pittosporum viscidum
Pittosporum undulatum
Pittosporum multiflorum
Auranticarpa rhombifolia
Bursaria incana
Bursaria spinosa
Hymenosporum flavum
Polyscias elegans
Pennantia cunninghamii
Quintinia verdonii
Citronella moorei
Solanum inaequilaterum
Duboisia myoporoides
Notelaea longifolia
Notelaea microcarpa
Olea paniculata
Notelaea johnsonii
Vitex lignum-vitae
Clerodendrum floribundum
Clerodendrum tomentosum
Gmelina leichhardtii
Acmena hemilampra
Acmena smithii
Acmena ingens
Syzygium crebrinerve
Syzygium corynanthum
Syzygium oleosum
Syzygium francisii
Syzygium luehmannii
Gossia acmenoides
Gossia bidwillii
Lenwebbia prominens
Rhodamnia glabrescens
Xanthostemon oppositifolius
Rhodamnia whiteana
Rhodamnia argentea
Rhodamnia acuminata
Rhodamnia sp. Glastonbury
Rhodamnia rubescens
Rhodamnia dumicola
Pilidiostigma glabrum
Decaspermum humile
Gossia hillii
Backhousia myrtifolia
Backhousia kingii
Backhousia angustifolia
Backhousia subargentea
Gossia punctata
Rhodosphaera rhodanthema
Euroschinus falcatus

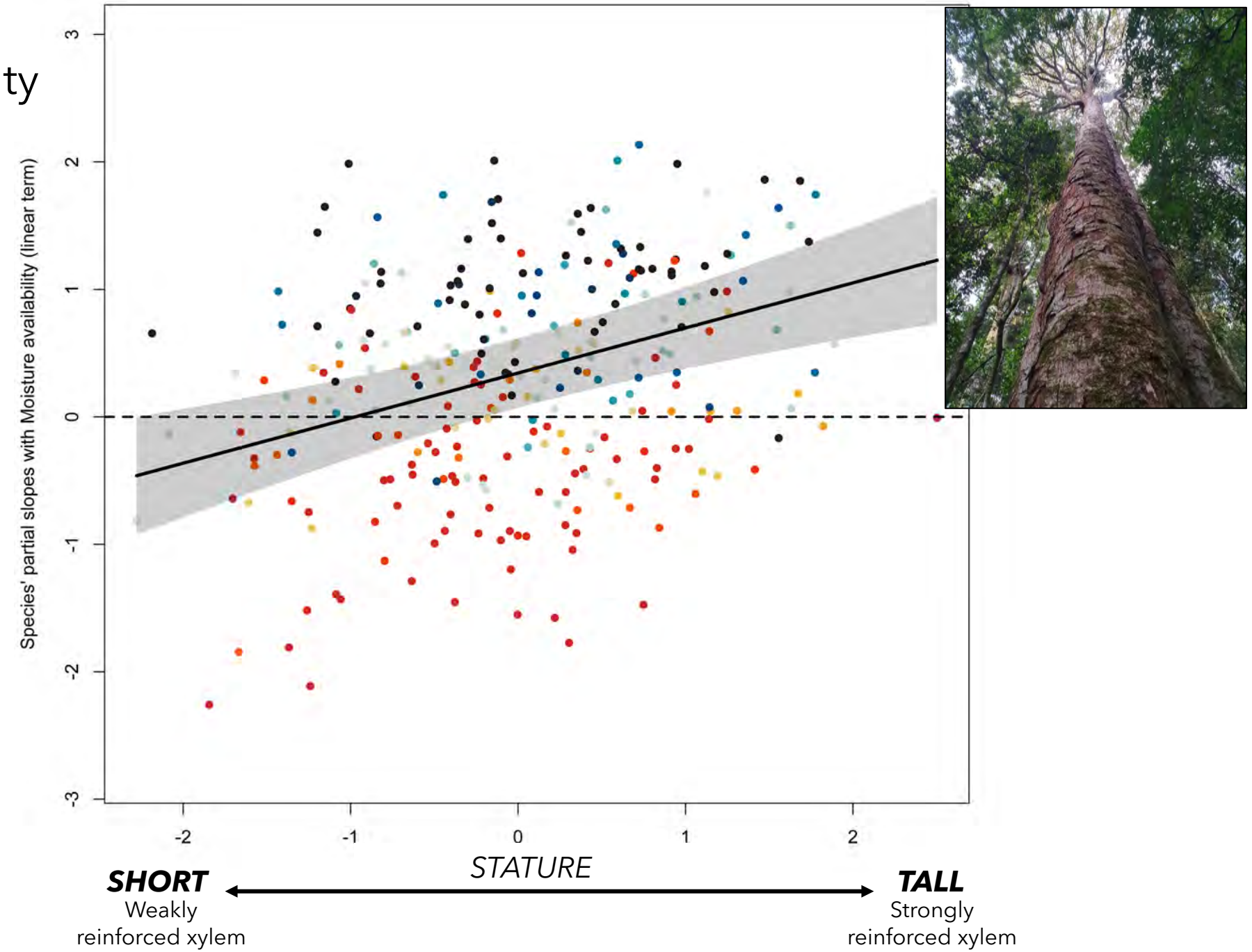
Table S3: PhyloGLMM results showing weak contribution of phylogeny to species' quadratic occurrence trends along Climate PC1. In the model, separate quadratic relationships with Climate PC1 were fitted for the 285 species as random effects. The phyloGLMM partitioned among-species variation in each coefficient (intercept, Climate PC1 and Climate $PC1^2$) into variance explained by phylogeny and remaining among-species variance not explained by phylogeny. The non-phylogenetic components were clearly dominant (>90%).

	Variance explained by phylogeny (%)	**Variance explained by species' differences**
Species' intercepts	0.116 (8%)	1.350 (92%)
Species' slopes with Climate PC1	0.043 (7.5%)	0.527 (92.5%)
Species' slopes with Climate $PC1^2$	0.0004 (4.2%)	0.009 (95.8%)

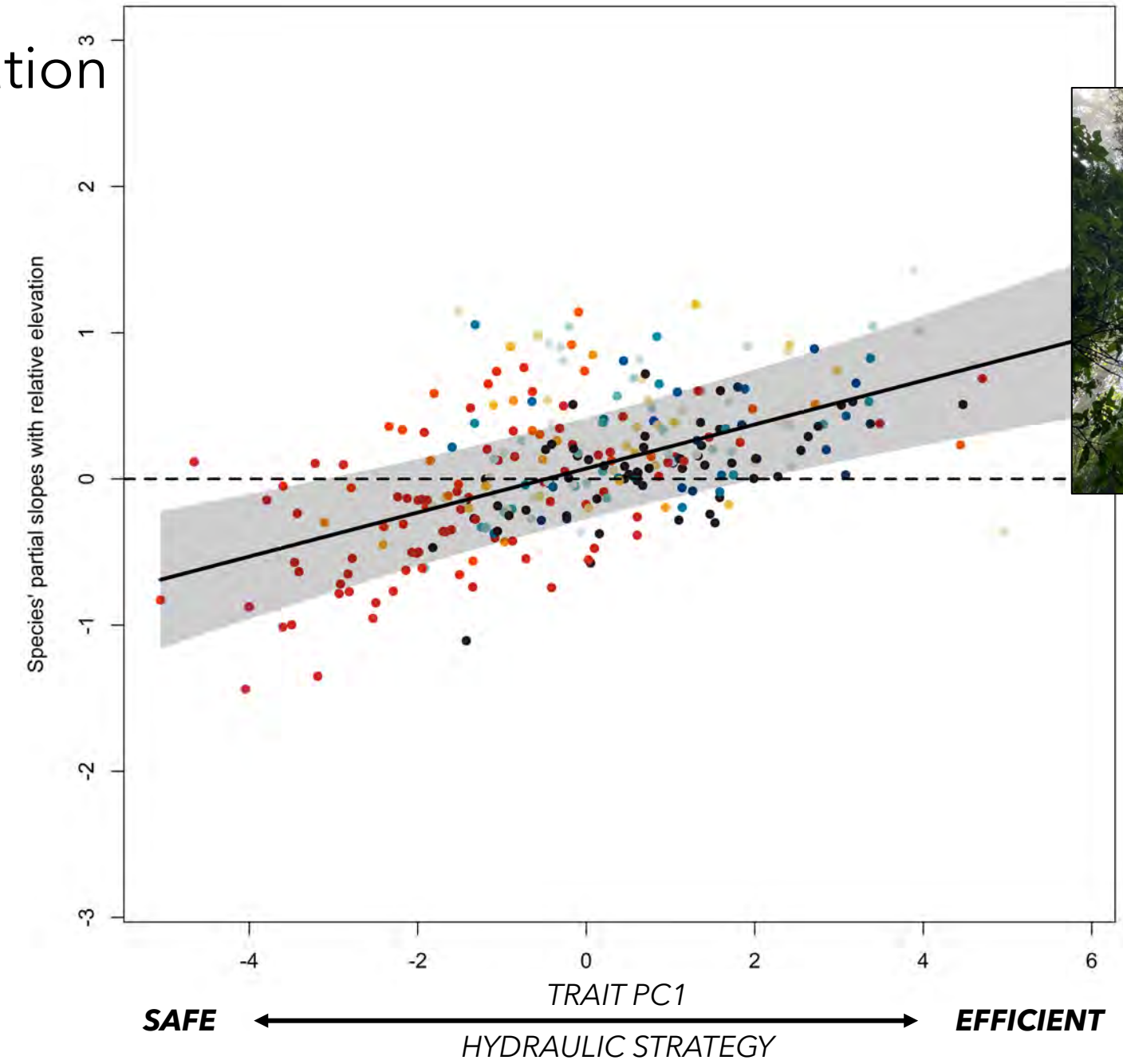
Trait variance components



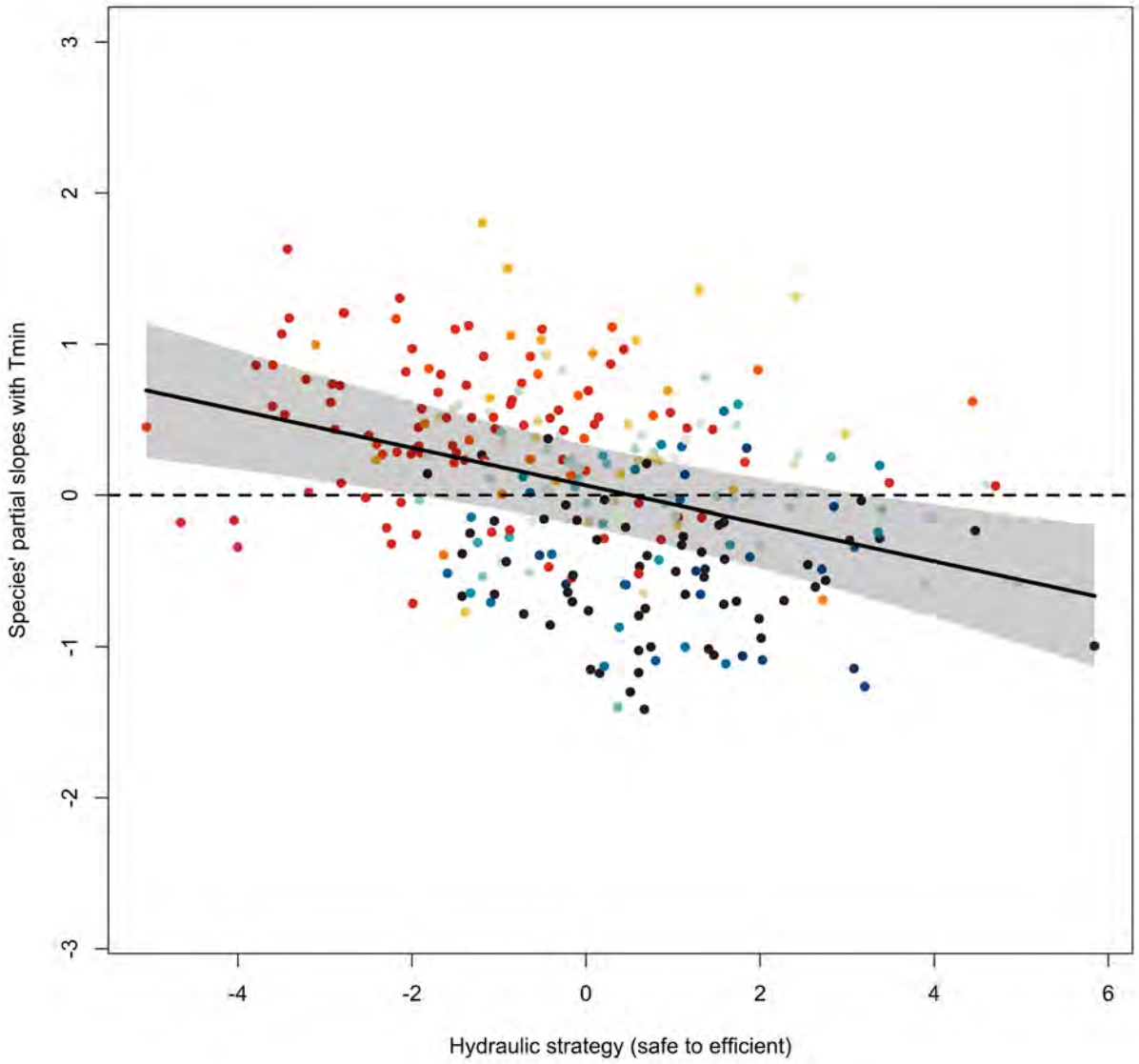
Stature *
Moisture availability

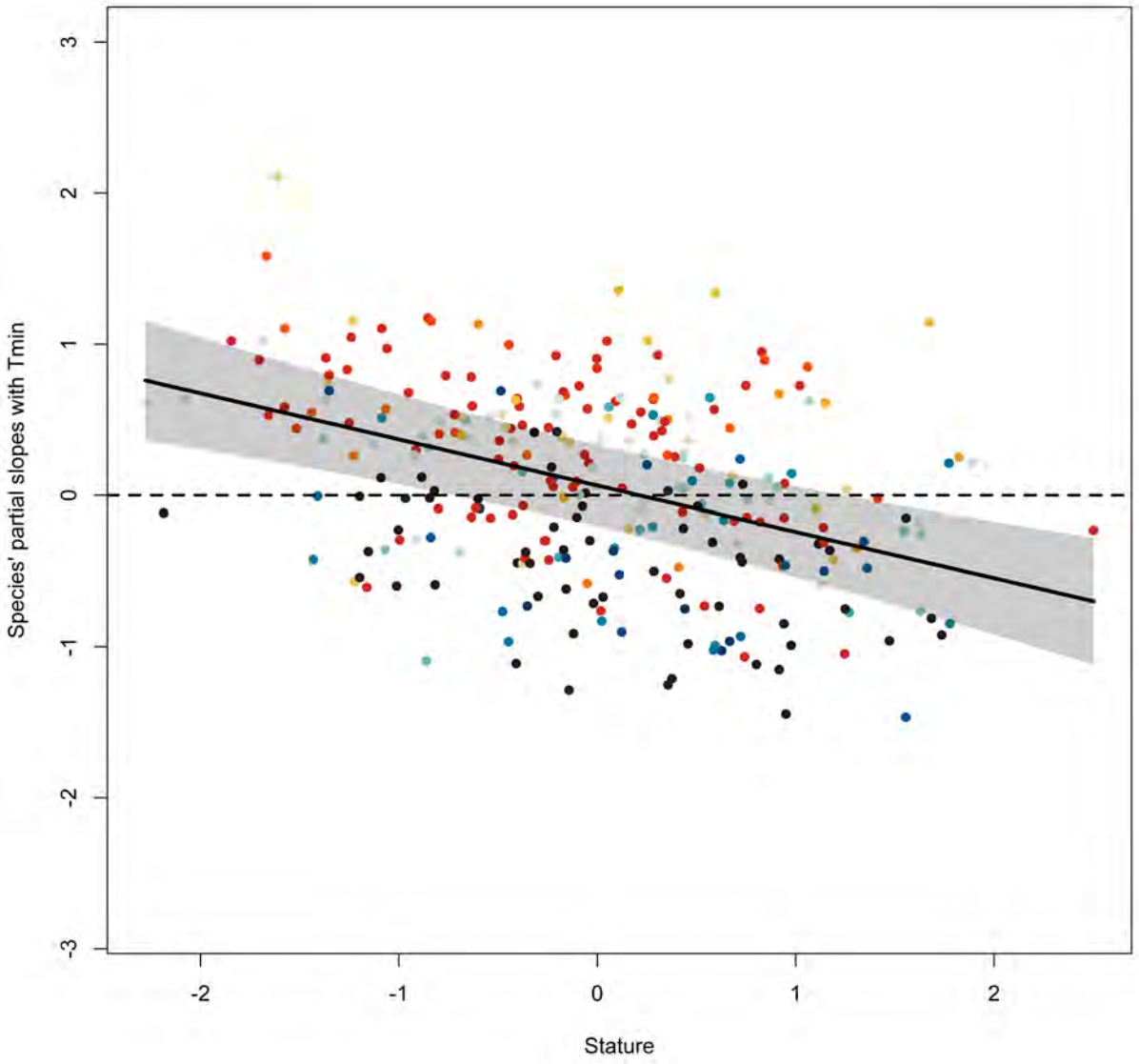


Trait PC1 * Relative Elevation



Minimum temperature





Leaf economics