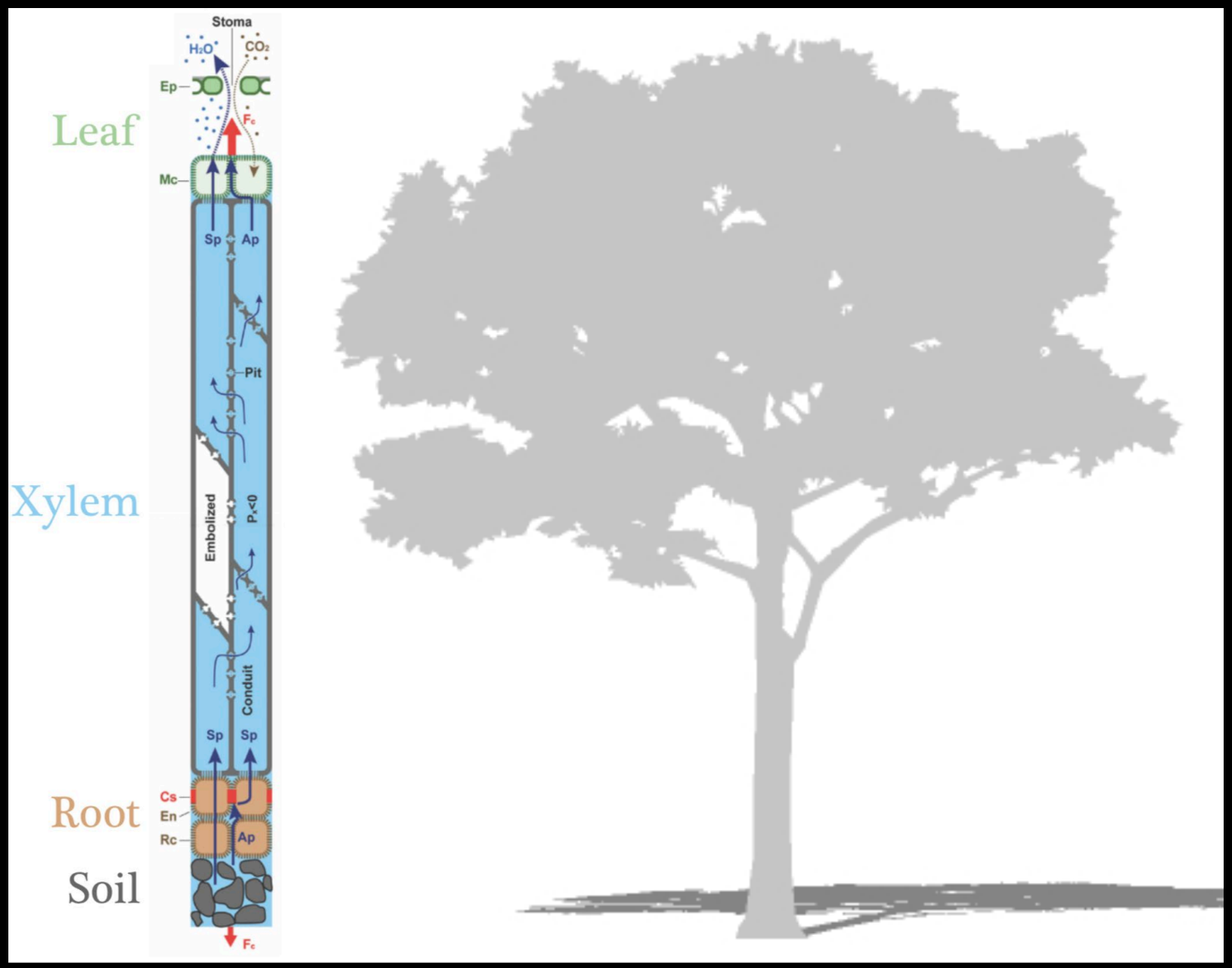
Canaries in the Coal Mine: Urban canopy research reveals climate impacts on native forests.

Aaron R. Ramirez, PhD
Prather, H, Brase, C, Price, G, Zhu, E, Bull, E, Aldrich JA, De Guzman, MD, Moffett, K, Rosenstiel, T, Shandas, V



REED
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Good

Fair

Good

Good

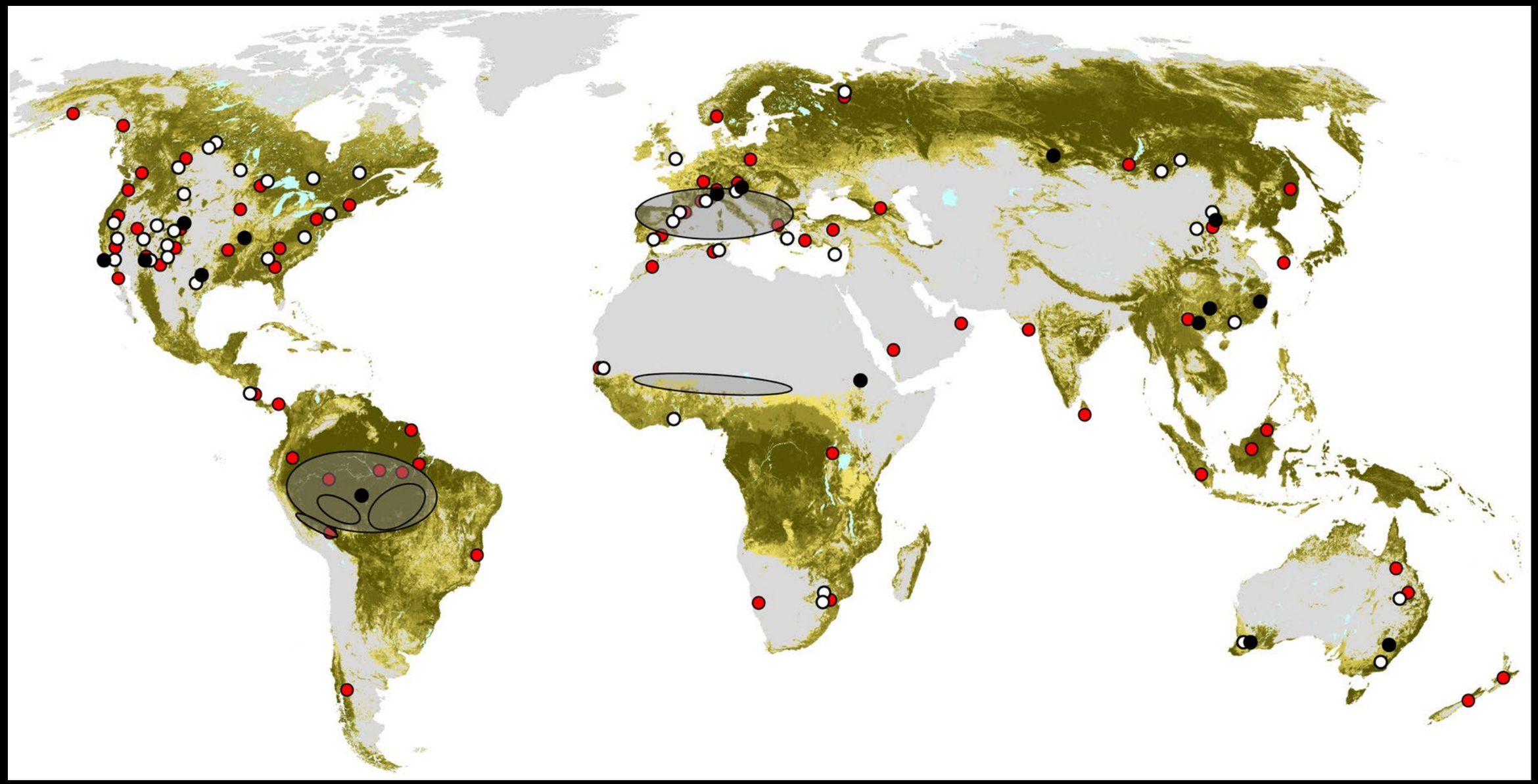
1. How can we better detect vulnerabilities in our urban forests?

2. What can urban trees tell us about the fate of our native trees and forests?

~150,000,000 dead trees in CA, and counting…

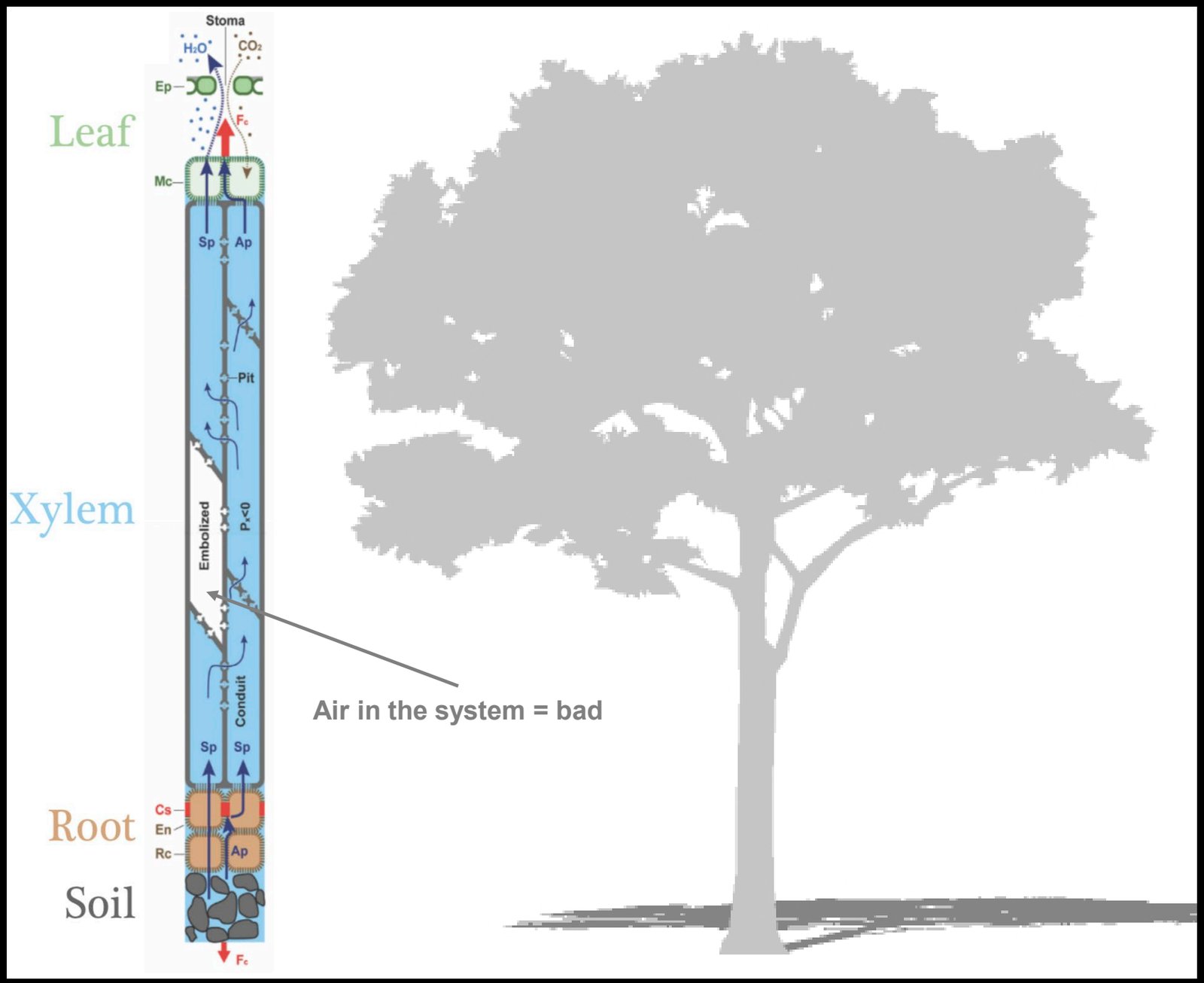
U.S. Forest Service

Rising temperatures drive tree mortality.



Allen et al. (2015), Ecosphere

What's the mechanism?



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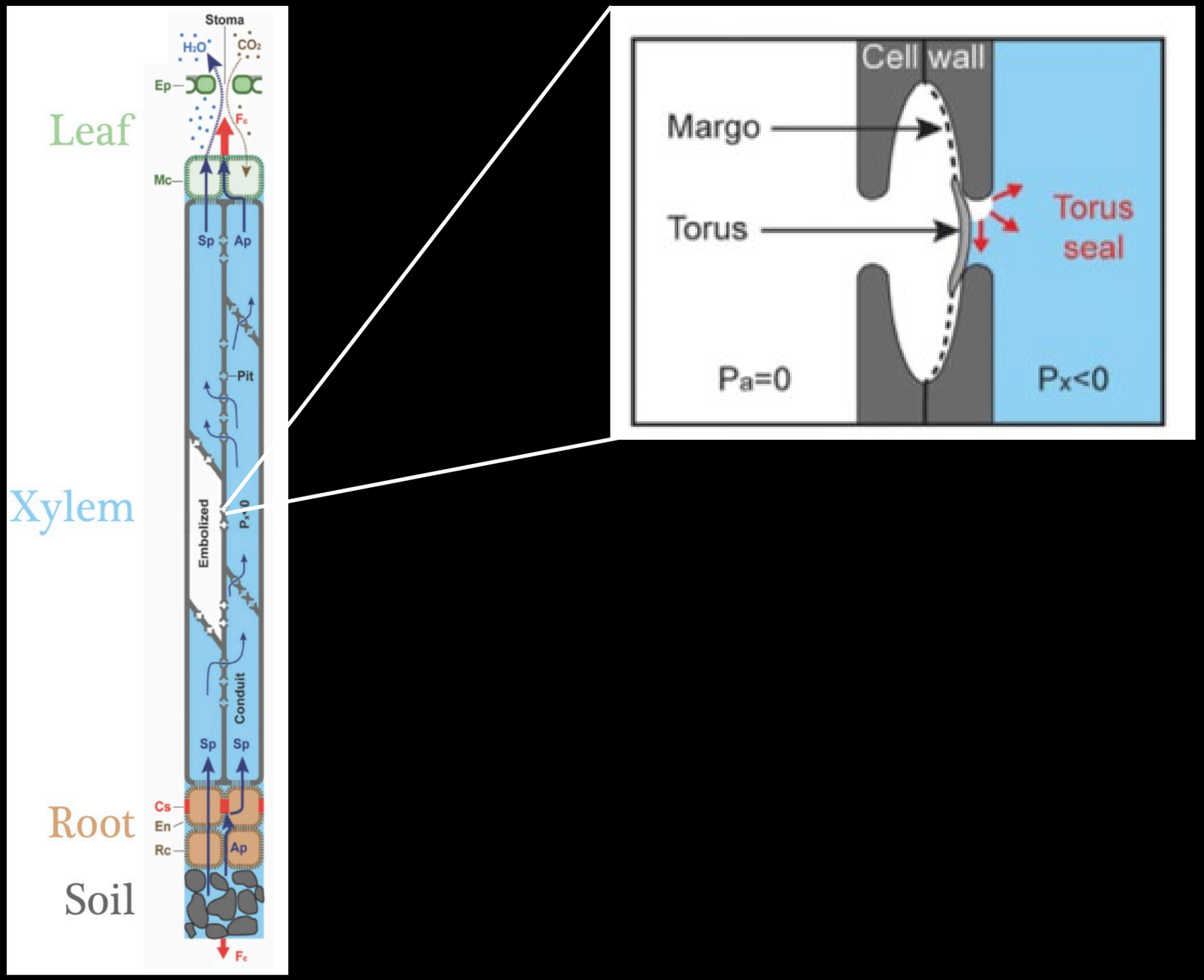

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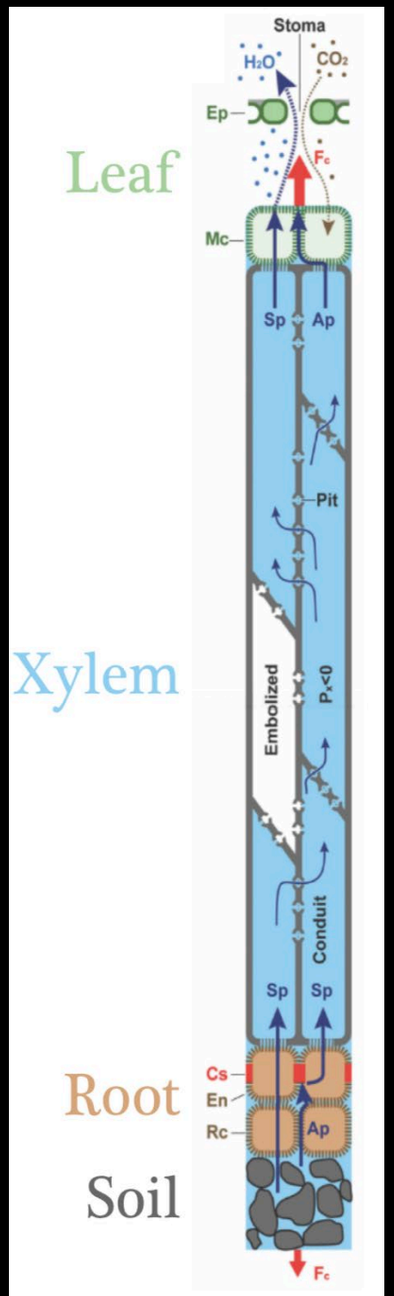
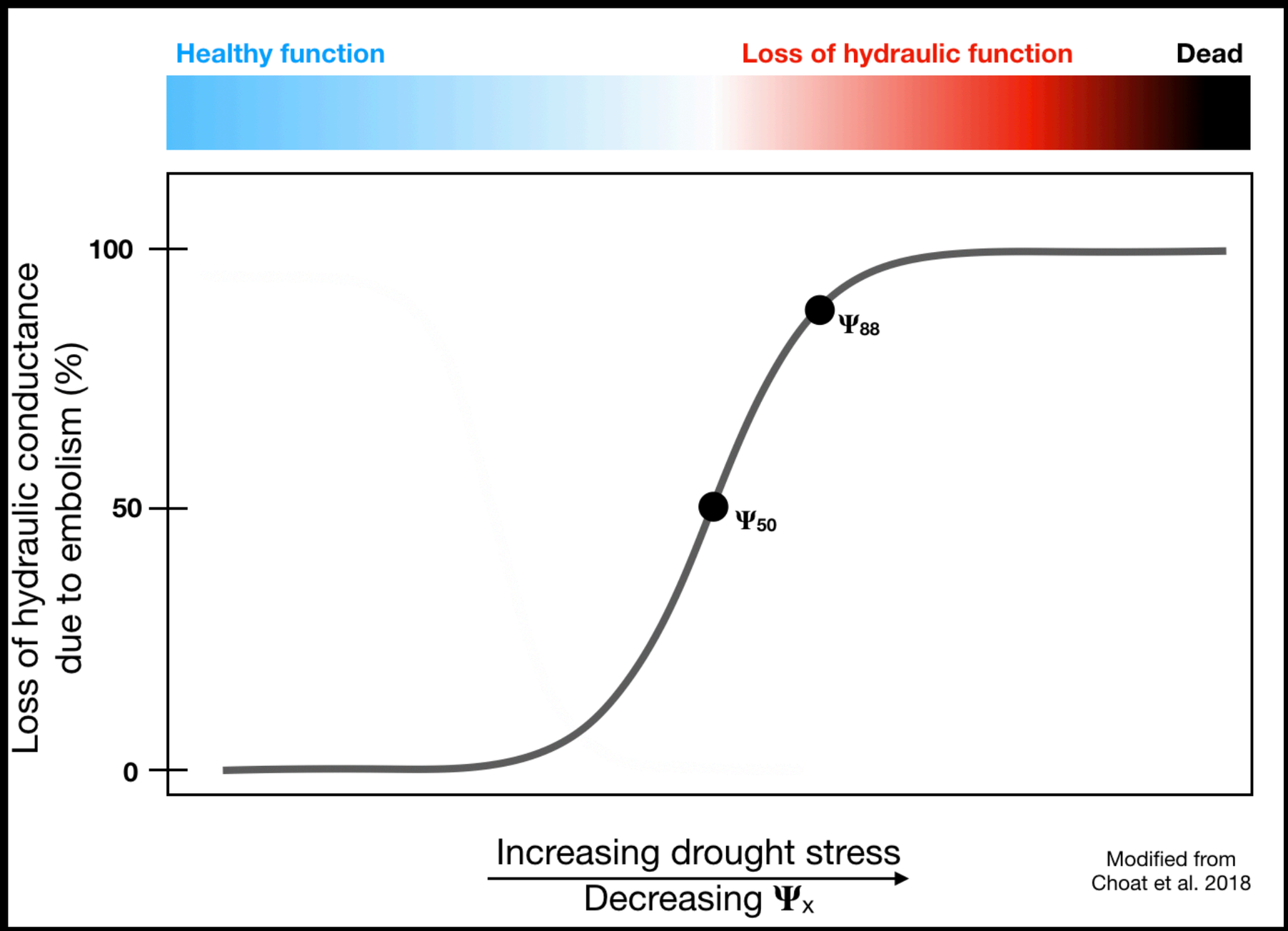
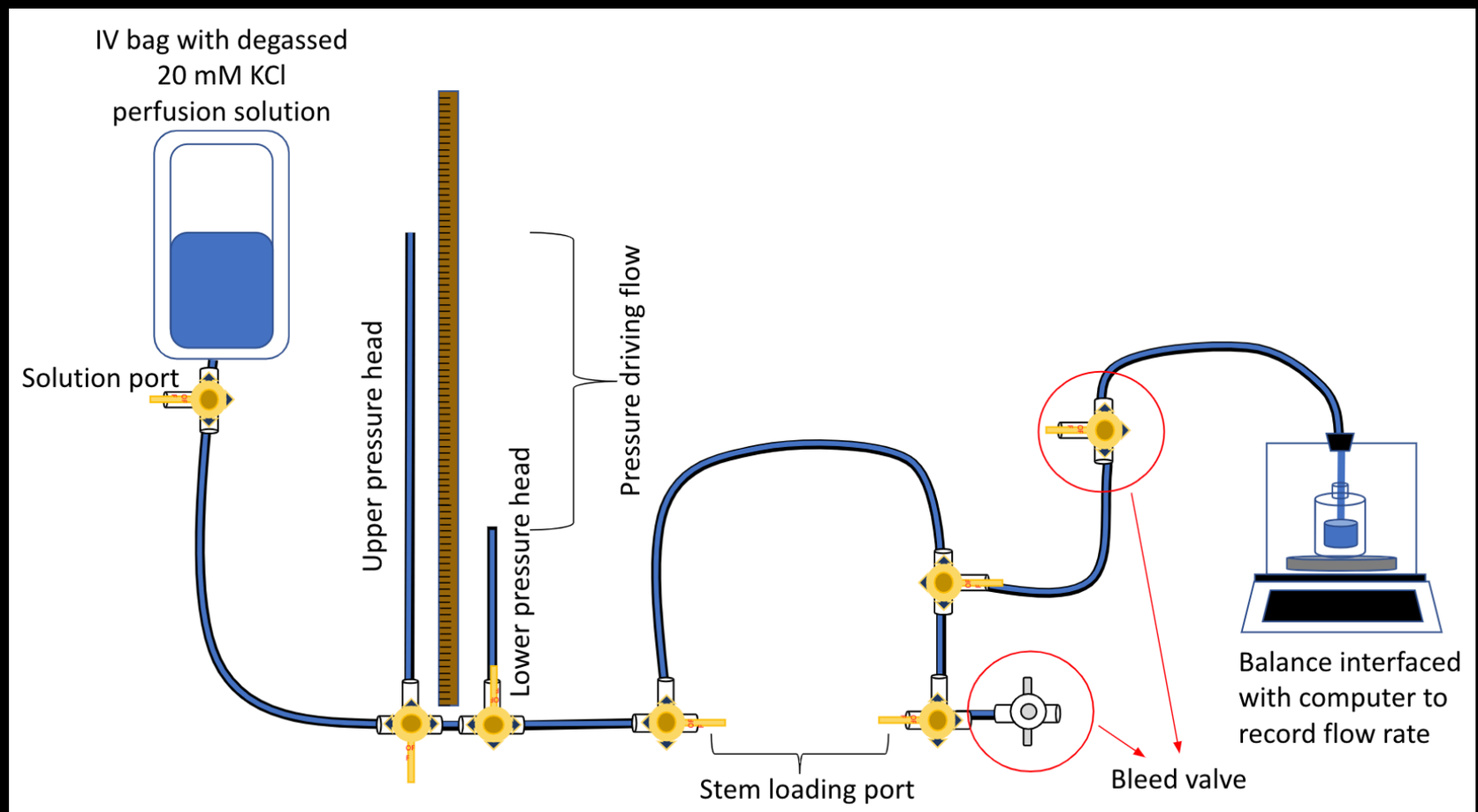


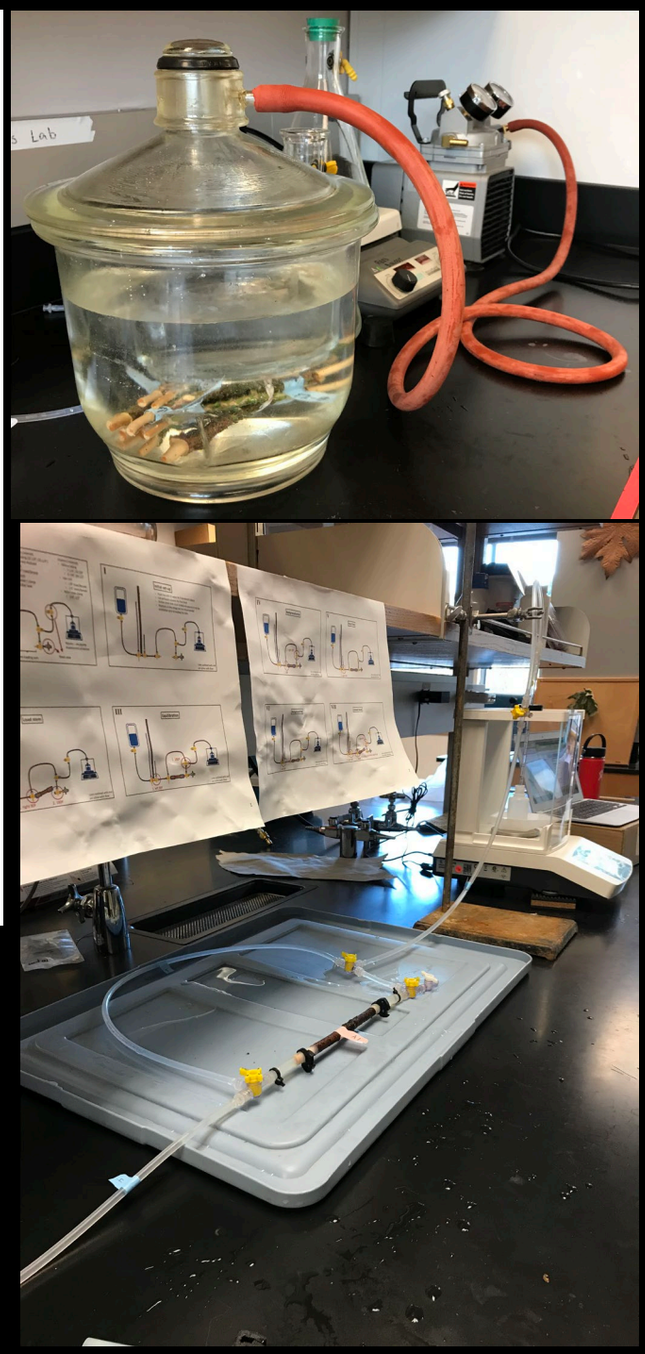


Tree Climbing: Sample Collection

B-5

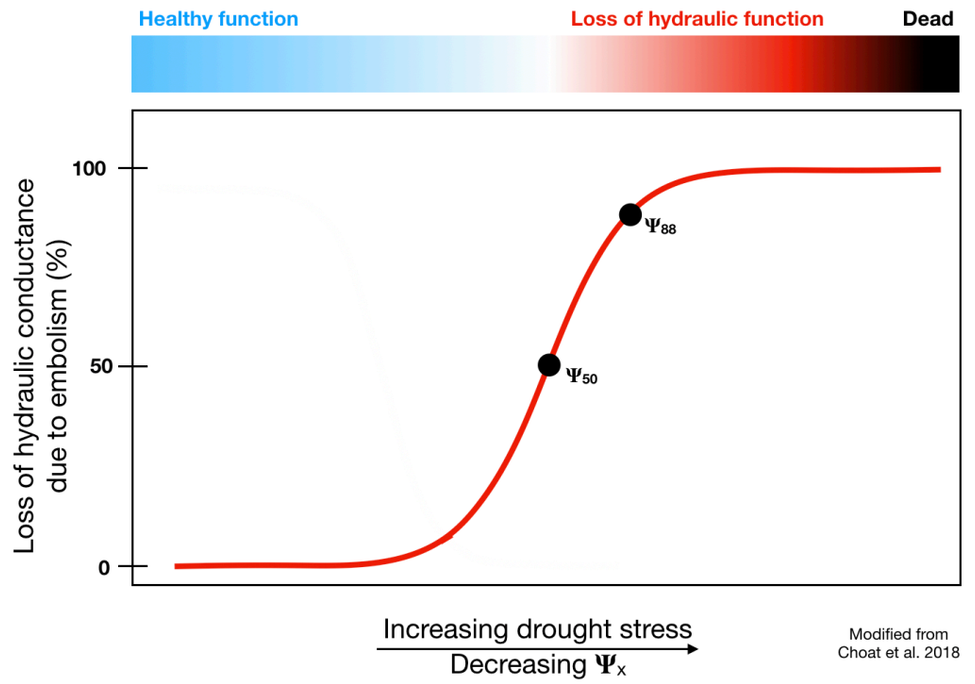
Measuring Hydraulic Conductivity:
Sperry Apparatus (Sperry et al., 1988)





The Centrifuge Method

	radius	20 C	
P (MPa)	r	p	RPM
0.25	0.0645	998.21	3313
0.5	0.0645	998.21	4686
0.75	0.0645	998.21	5739
1	0.0645	998.21	6627
1.25	0.0645	998.21	7409
1.5	0.0645	998.21	8116
1.75	0.0645	998.21	8767
2	0.0645	998.21	9372
2.5	0.0645	998.21	10478
3	0.0645	998.21	11478
3.5	0.0645	998.21	12398
4	0.0645	998.21	13254
4.5	0.0645	998.21	14058
5	0.0645	998.21	14818
5.5	0.0645	998.21	15542
6	0.0645	998.21	16233
7	0.0645	998.21	17533
8	0.0645	998.21	18744
9	0.0645	998.21	19881
10	0.0645	998.21	20956
11	0.0645	998.21	21979
12	0.0645	998.21	22957



Alder *et al.* 1997

Recent findings from the Ramirez Lab:

- Increasing temperatures change hydraulic vulnerability of trees.
- Air pollution increases rates of evaporative water loss from trees.
- Tall urban trees are more vulnerable to climate change.

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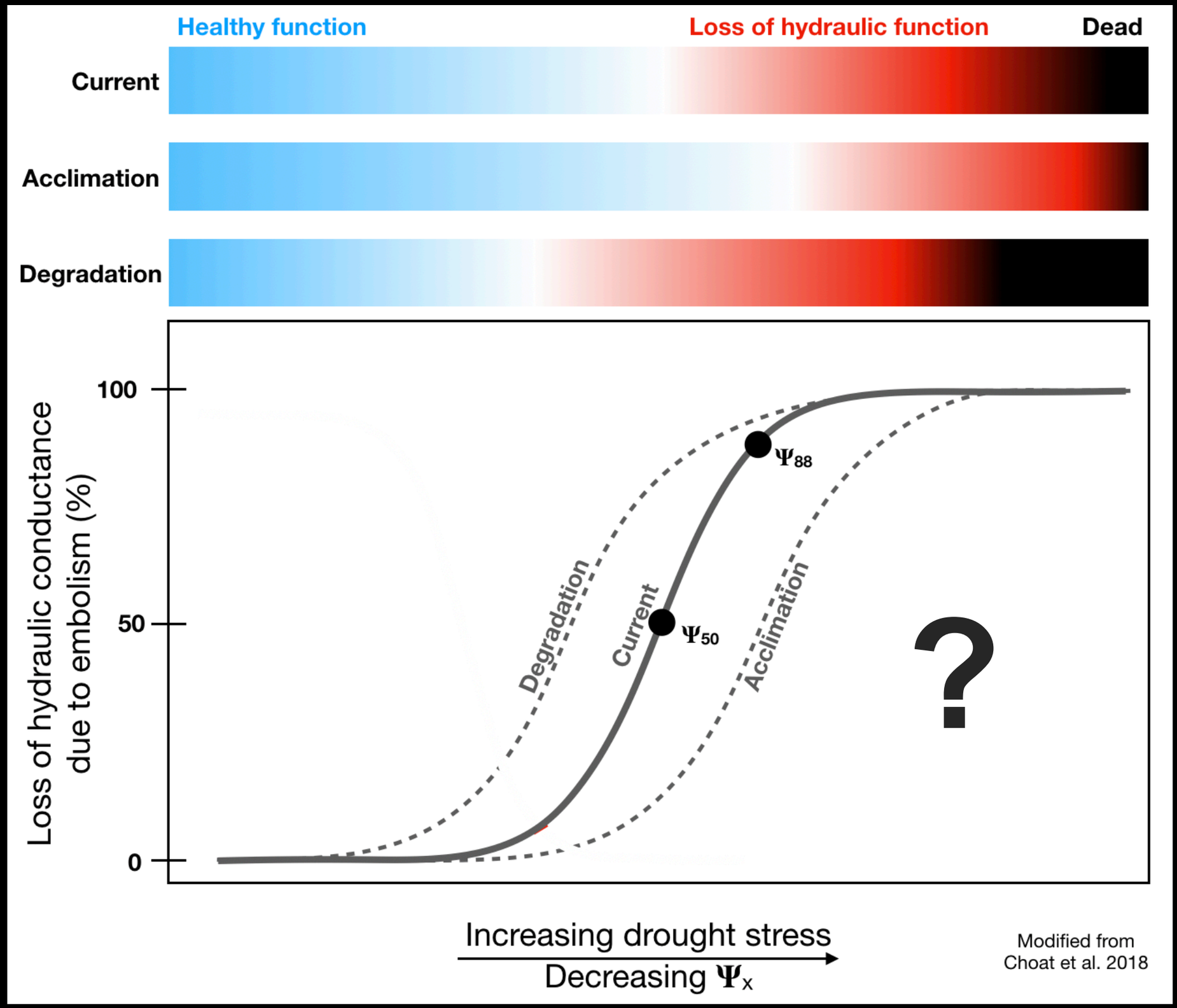
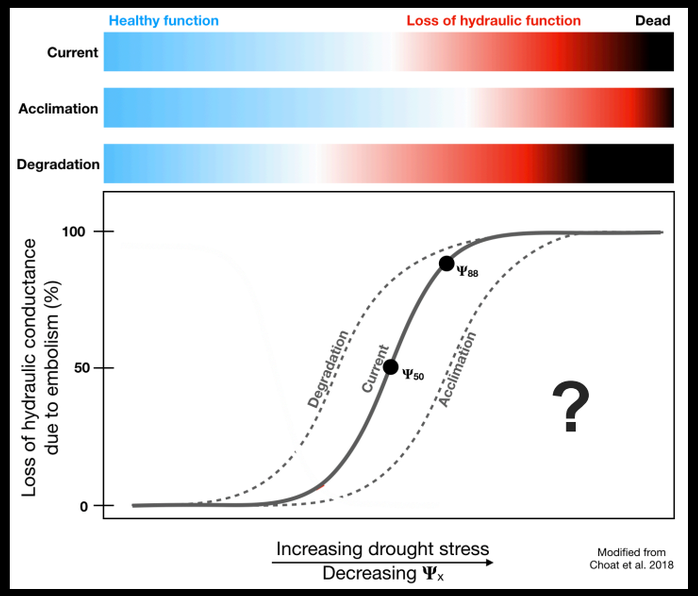
Will trees acclimate to future climate warming?

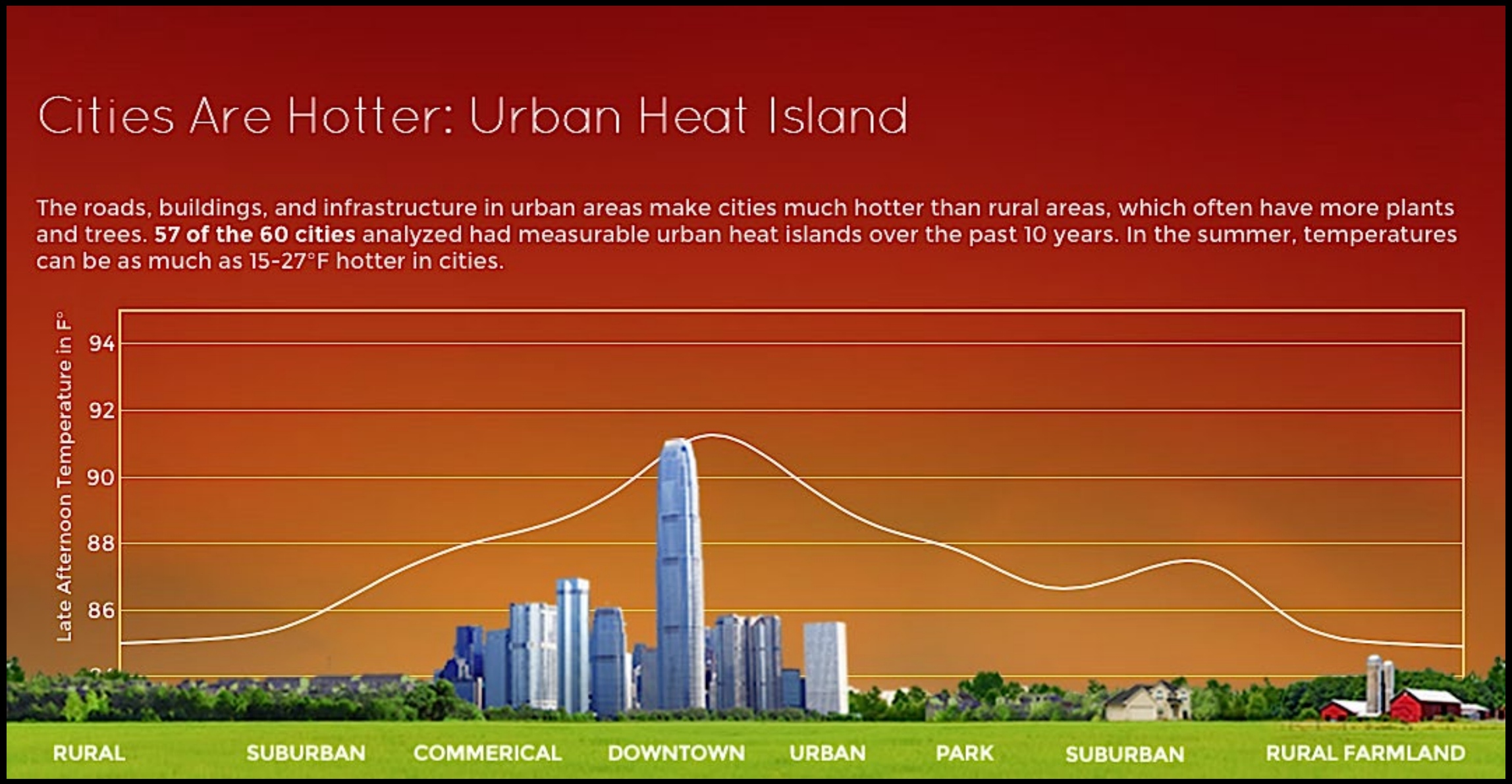




Option A

Option B

Option C

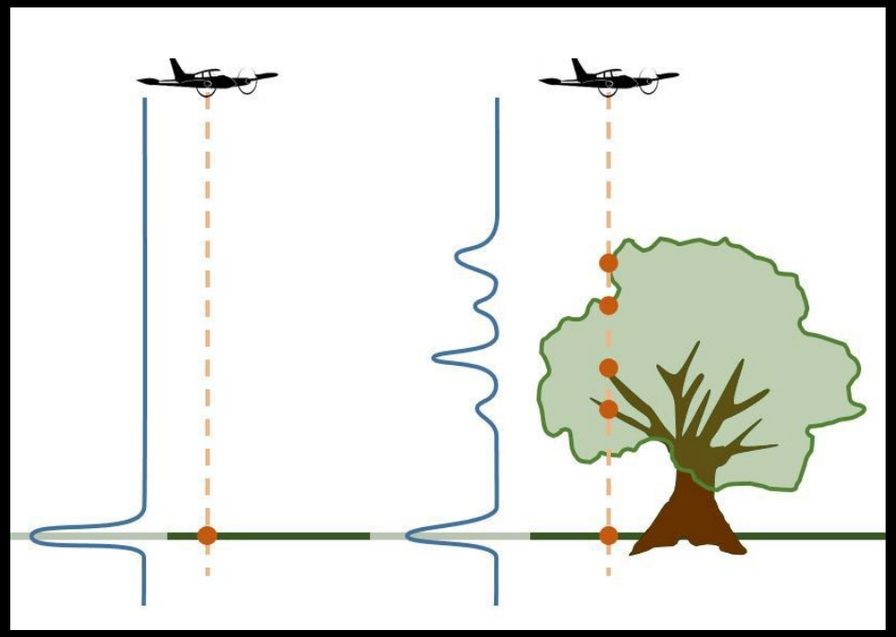


Source: CleanTechnica.com

Trees in cities are already experiencing end of century temperatures!

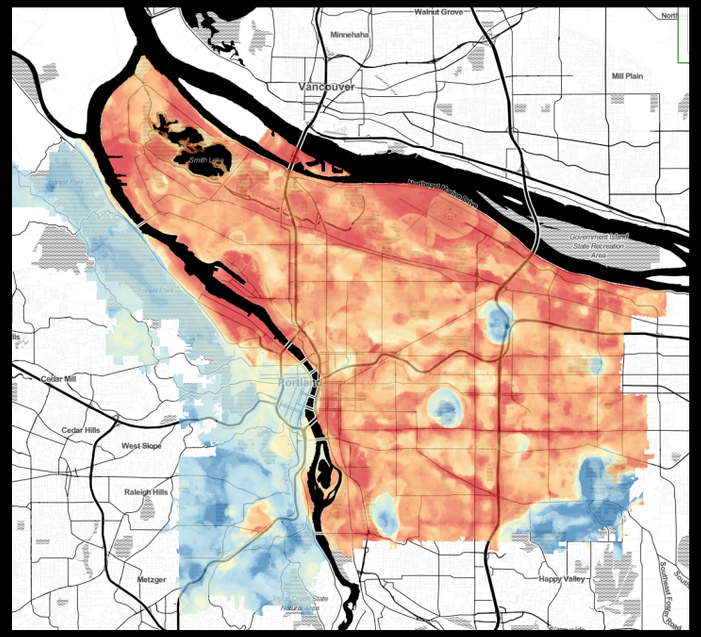
Canopy Analytics

Where are the trees?



LiDAR

Where are the UHIs?



Temperature Modeling/ remote sensing

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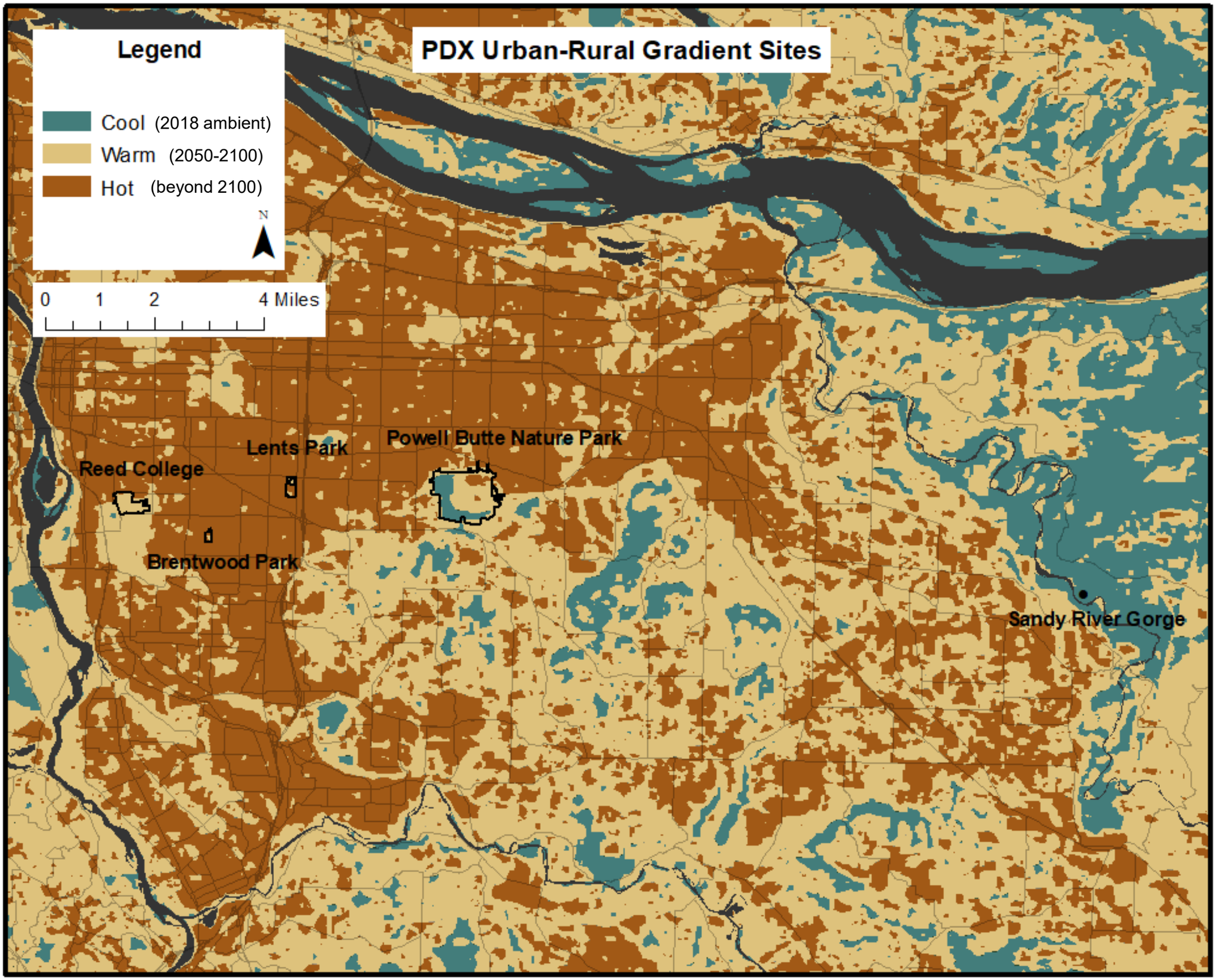
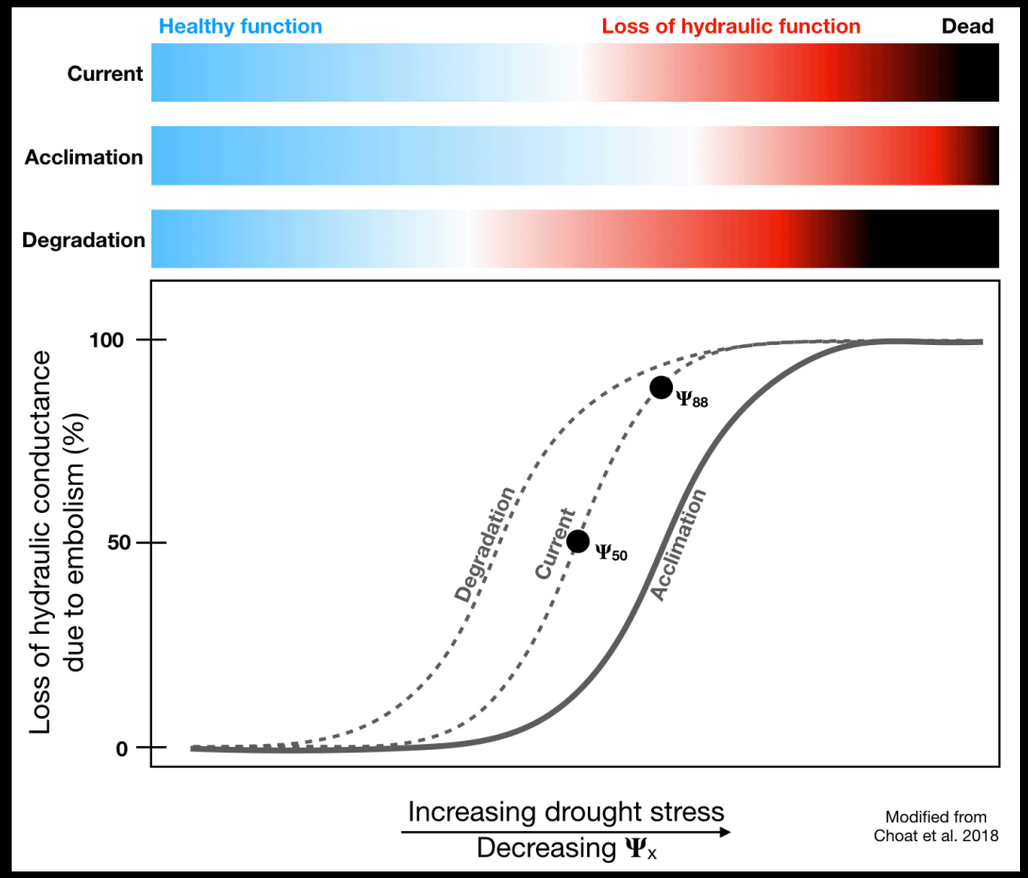
Urban heat as a proxy for climate change.



Hypothesis: Trees acclimate to increasing urban heat, maintain healthy hydraulic function



P. menziesii

A. mcrophyllum

T. plicata

Gradient Sites	Hot Urban Park	Warm Urban Park	Cool Urban Park	Cool Rural Forest
Urban Heat Exposure	High	Intermediate	Low	Low
Neighboring Tree Cover	Low	Intermediate	High	High
Tree Size	60’ (ACMA, THPL) 100’ (PSME)	60’ (ACMA, THPL) 100’ (PSME)	60’ (ACMA, THPL) 100’ (PSME)	60’ (ACMA, THPL) 100’ (PSME)
Site Name	Lents Park	Reed College	Powell Butte	Sandy River Gorge

Results

Douglas-fir

- High acclimation potential, cool to warm
- No acclimation, warm to hot
- May reach limits under extreme climate change

Bigleaf Maple

- No acclimation potential
- May offset with high Ks May reach limits under moderate climate change

W. redcedar

- High hydraulic degradation
- Already reaching limits, mortality risk high