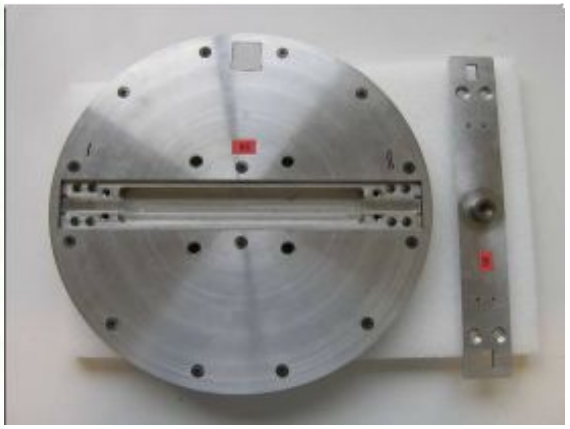
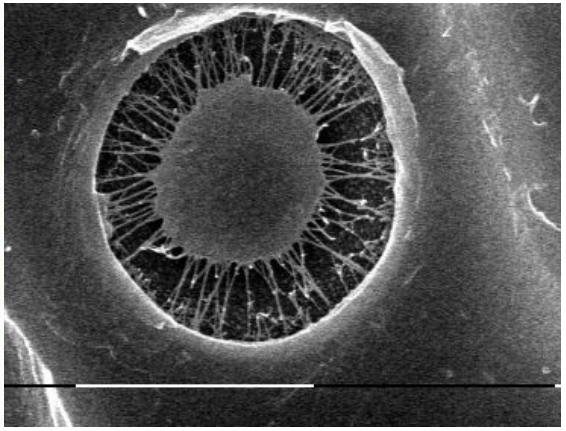
Cavitating the conifers of the world





Sylvain Delzon

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http://sylvain-delzon.com

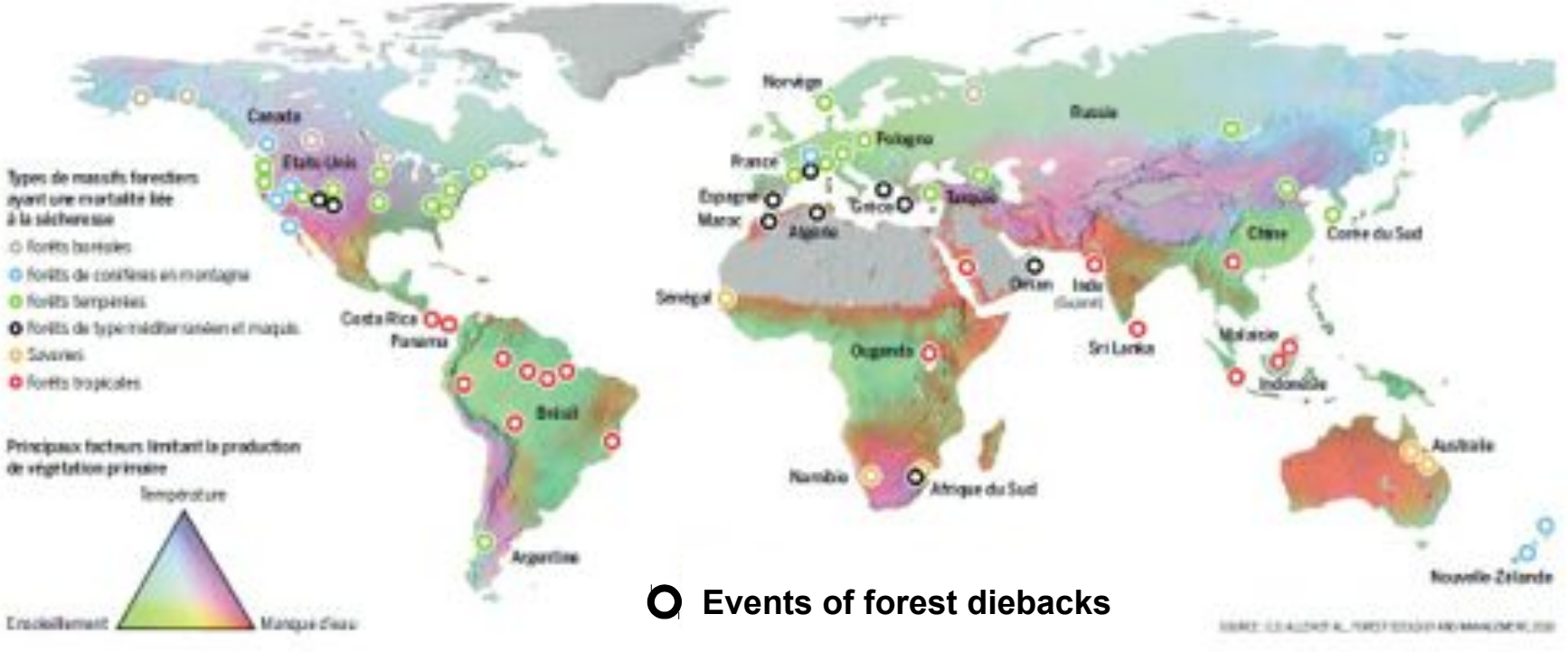
Biodiversité, gènes & communautés

Beauty of conifers

Larix laricina
Picea likiangensis cones
Abies delavayi
Pinus ponderosa cones

Drought-induced forest dieback

Allen *et al.* (2010)




P. tremuloides (Canada)


N. dombeyi (Argentine)


P. sylvestris (Suisse)

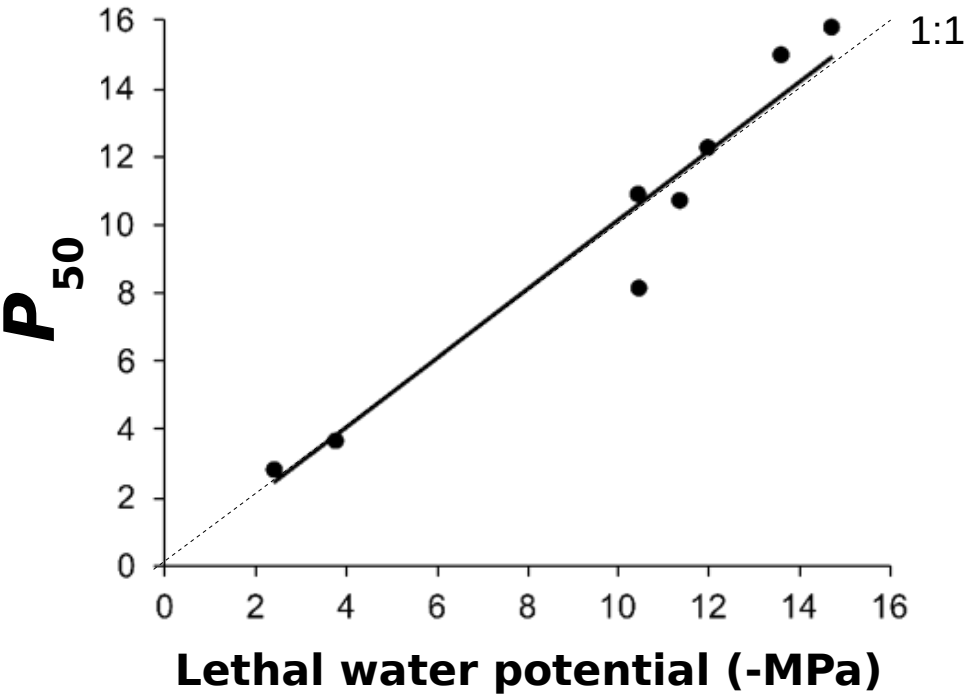

Acacia sp. (Australie)

Carbon starvation
or
hydraulic failure?

Photo credits: Dr. Hervé Cochard (INRA, Clermont-Ferrand, France).

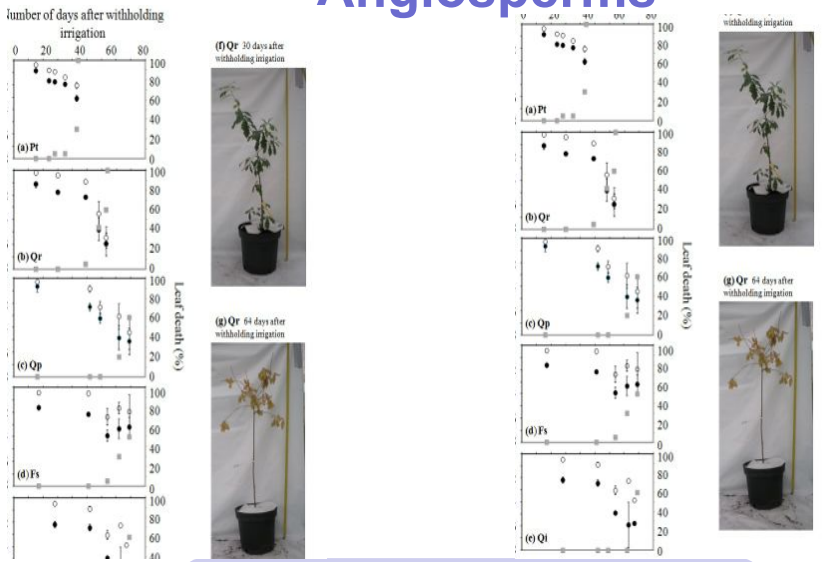
Drought-induced mortality: Is cavitation resistance a relevant trait?

Conifers

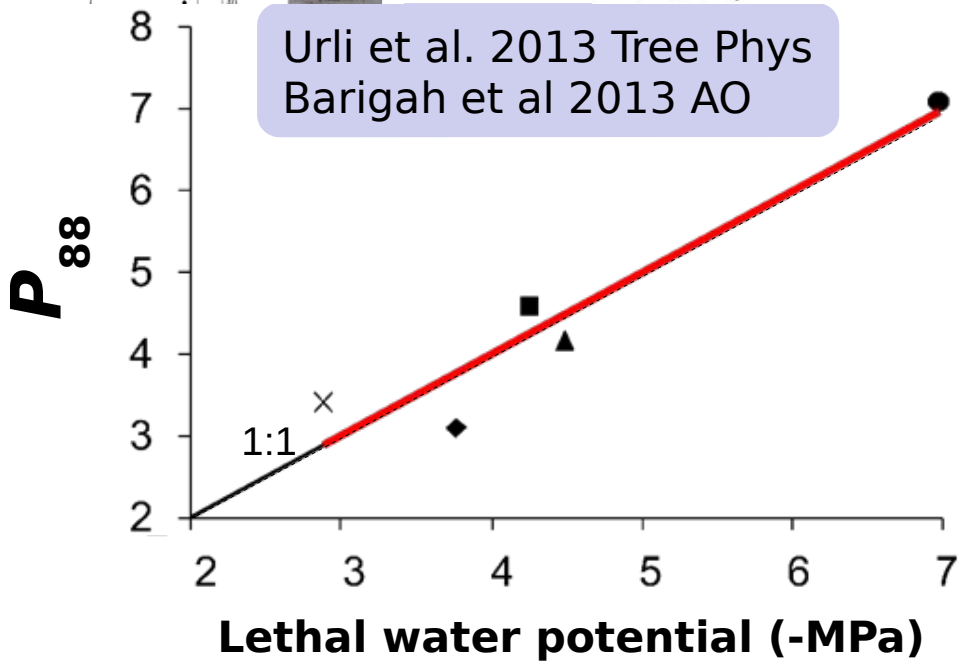


Brodribb and Cochard 2009 PP
Brodribb et al. 2010 New Phytol

Angiosperms

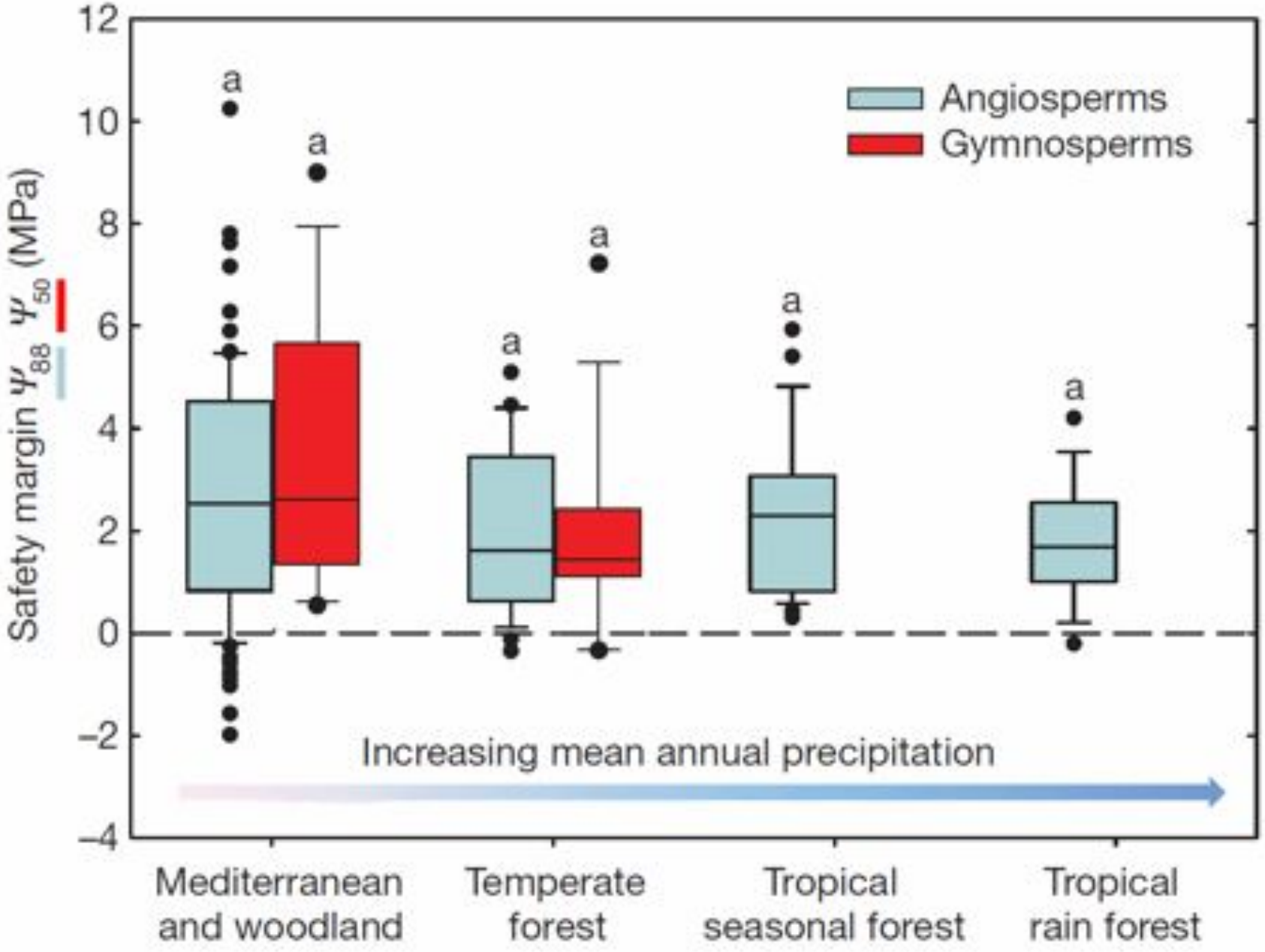


Urli et al. 2013 Tree Phys
Barigah et al 2013 AO



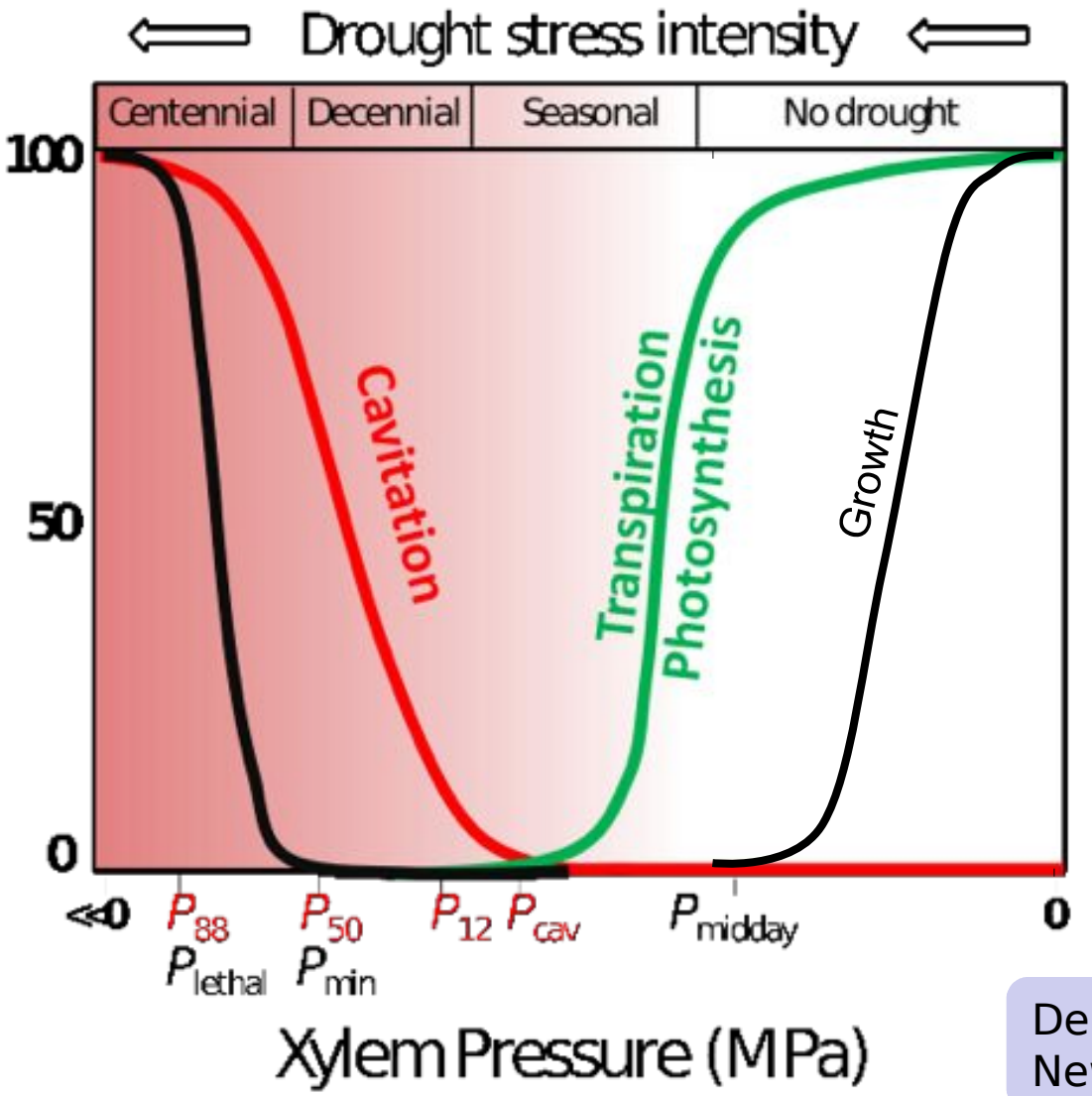
Different xylem embolism thresholds for catastrophic hydraulic failure

Similar safety margins for angiosperms and conifers



Drought-induced xylem cavitation only occurs under severe drought

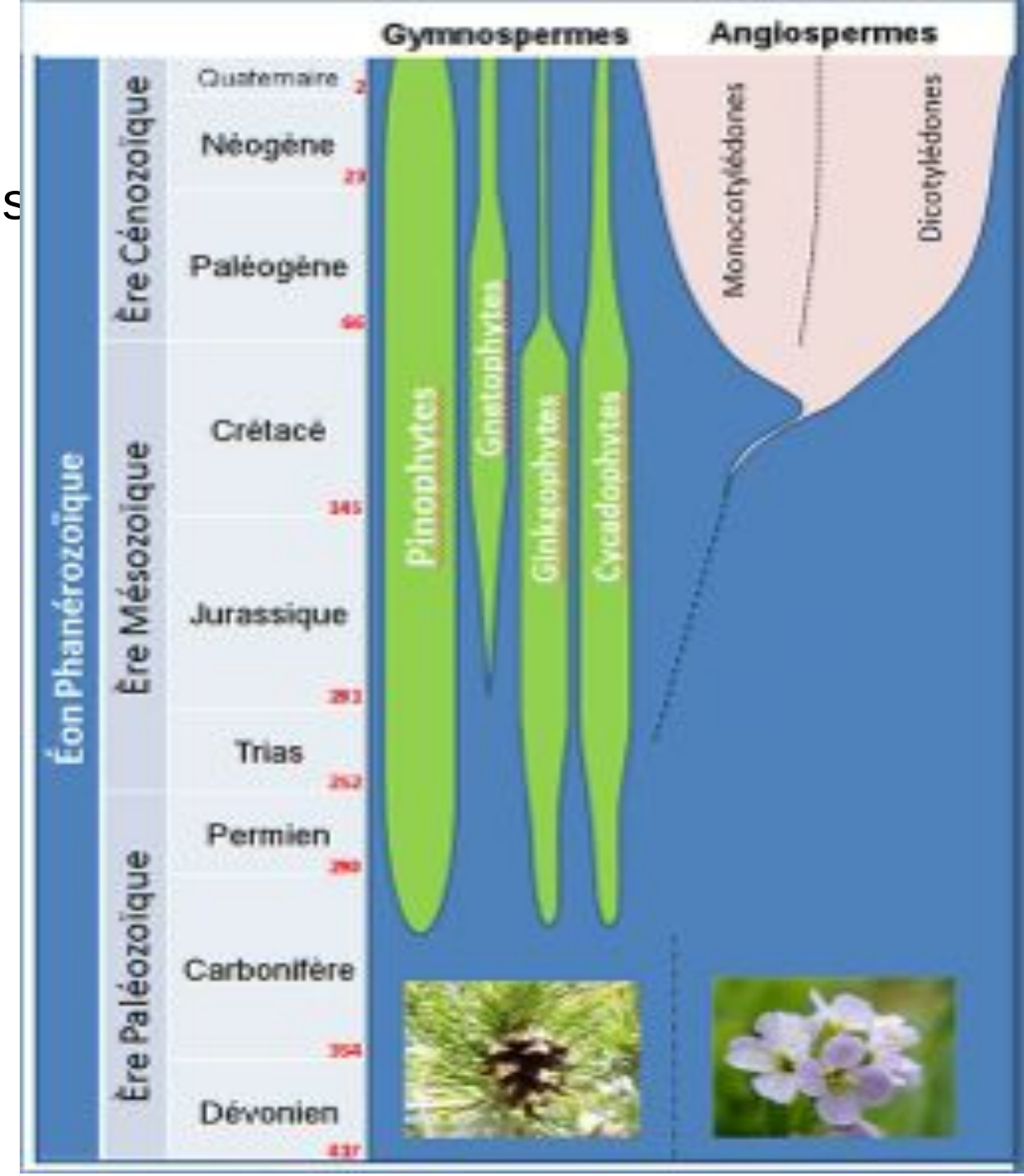
The high-cavitation-resistance paradigm should be viewed as the only valid framework for understanding plant hydraulics and water relations



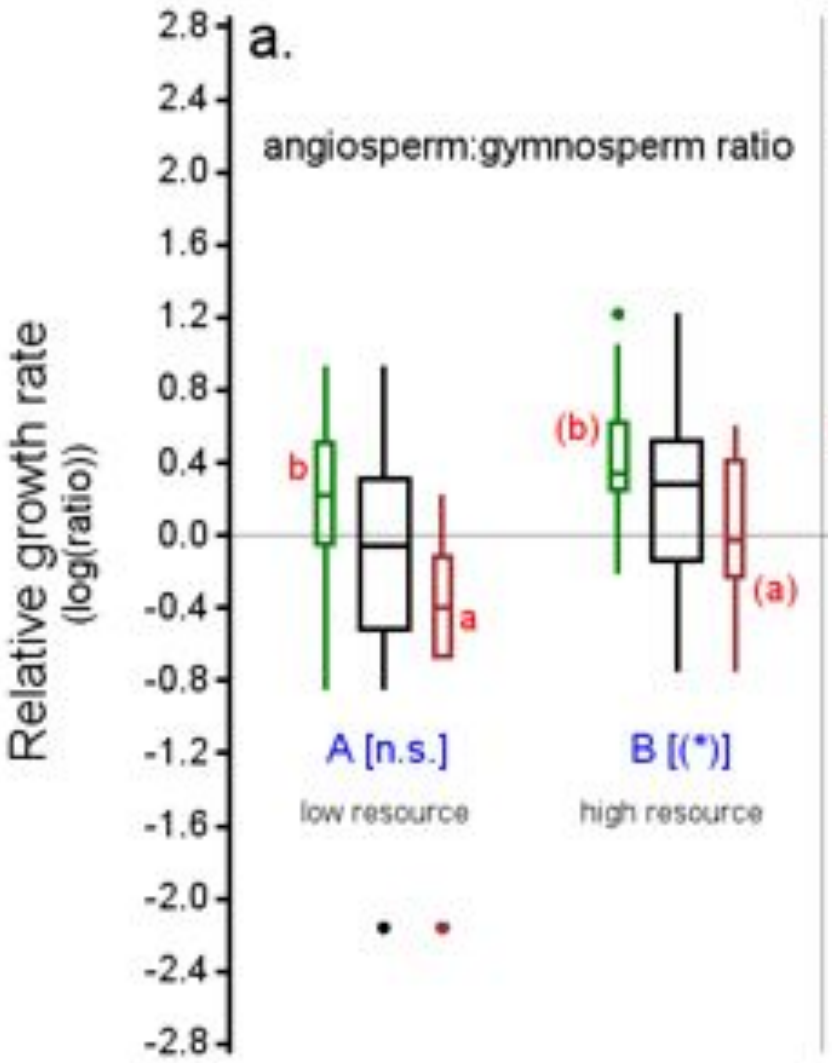
Delzon & Cochard 2014
New Phytol

The radiation of angiosperms vs. the decline of gymnosperms

Darwin's 'abominable mystery'.



H1 : The carbon hypothesis: Le LIÈVRE ET LA TORTUE
(the tortoise and the hare)

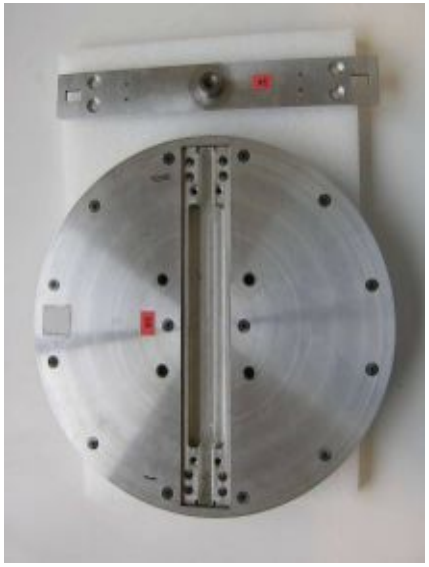


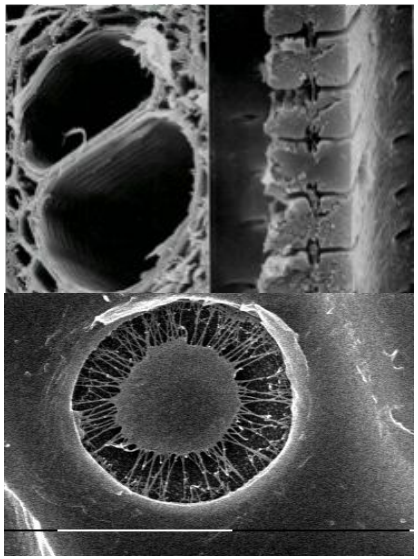
We found angiosperms to have similar growth rates as conifers when resources are scarce.

However, when the availability of resources is increased, angiosperm species tend to grow faster than coniferous species

H3. The climate hypothesis

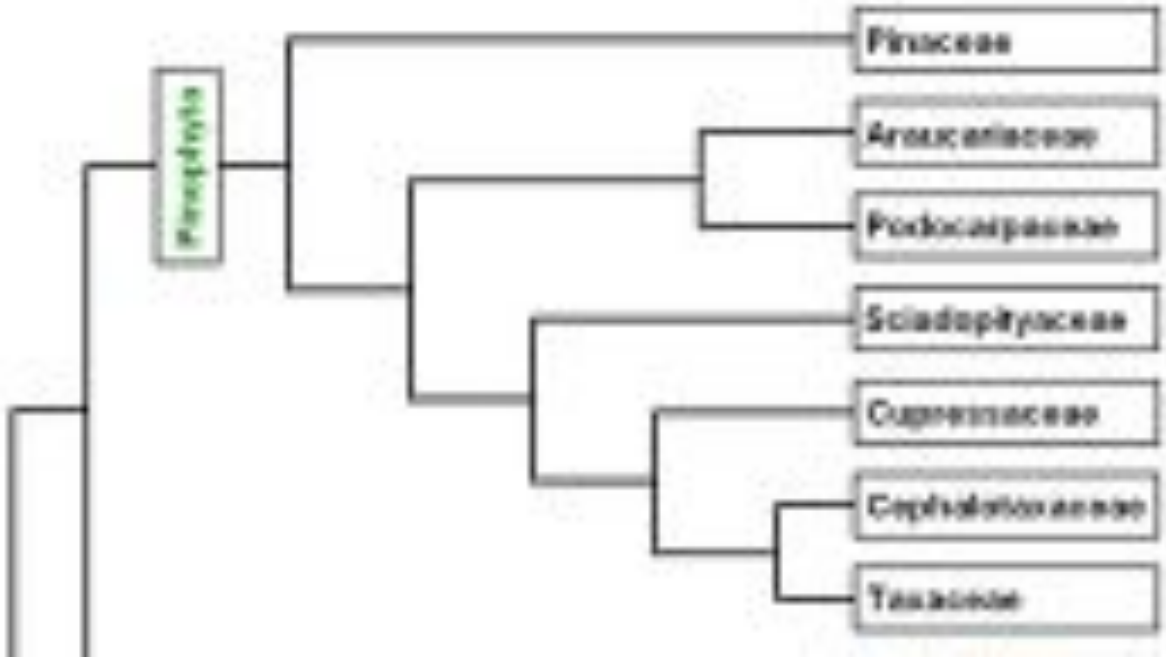
FROST and DROUGHT TOLERANCE





Sampling in Kew, Bedgebury, Sydney and Hobart

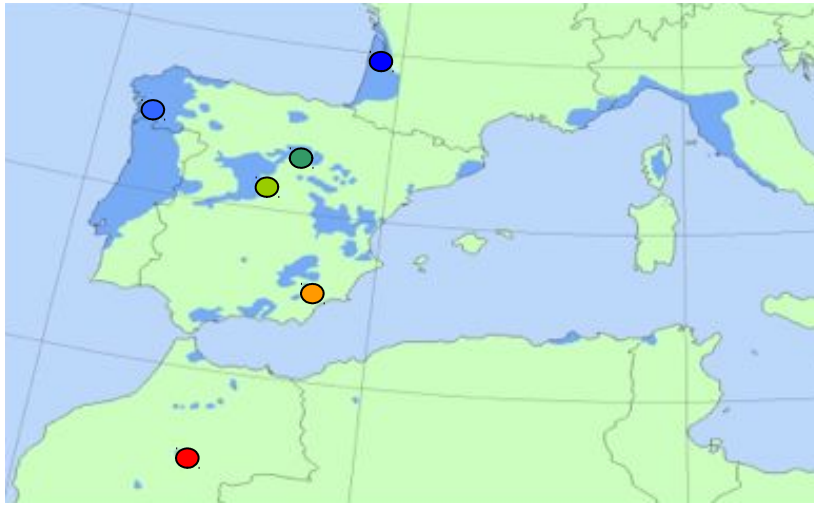
Cavitating the conifers of the world



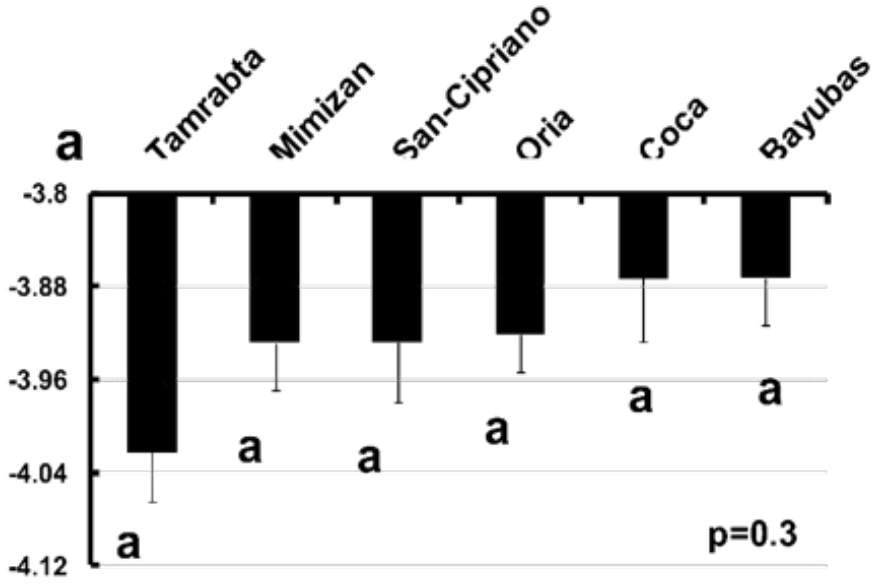
Taxonomic diversity of conifers and species measured for cavitation resistance

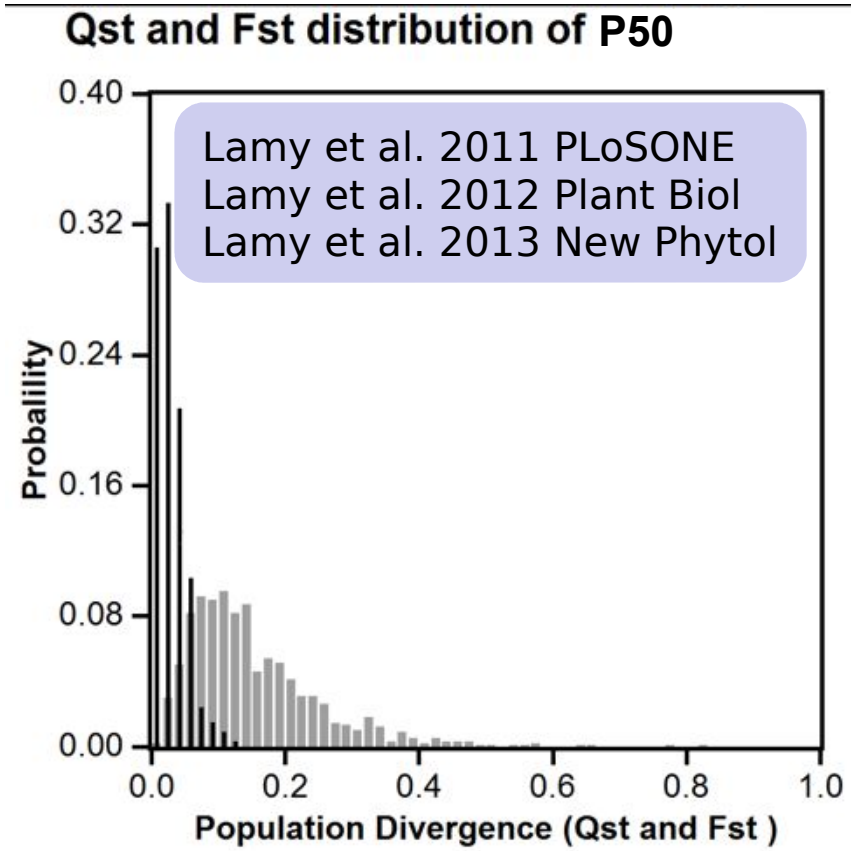
# species	Sampled species
228	86
41	25
190	57
1	1
133	70
11	4
23	8
627	264

Intra-specific variability (*Pinus pinaster*)



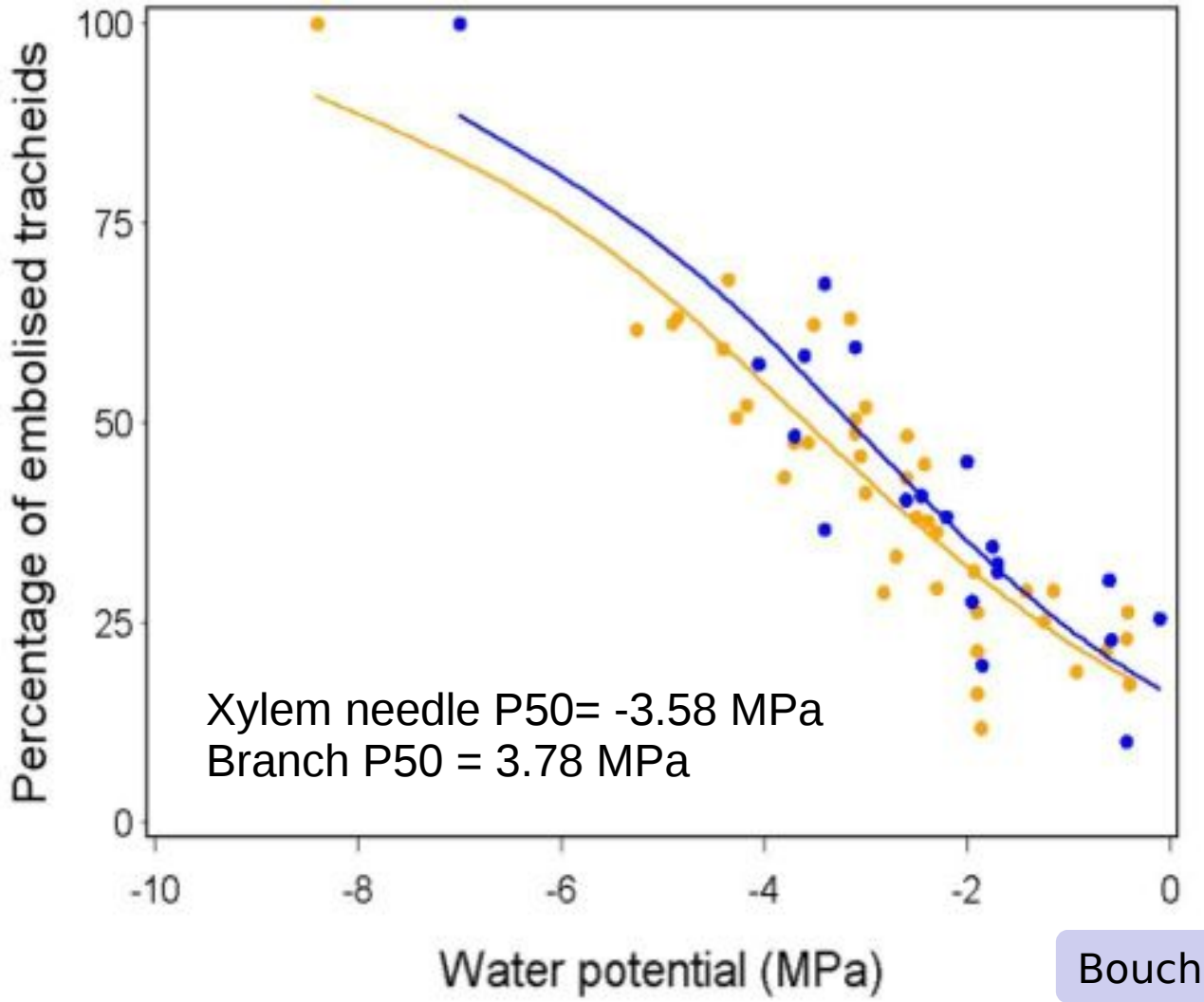
The QST<FST pattern can be interpreted as a canalization phenomenon or a consequence of uniform selection





Lack of genetic variation in cavitation resistance among populations across a species distribution range

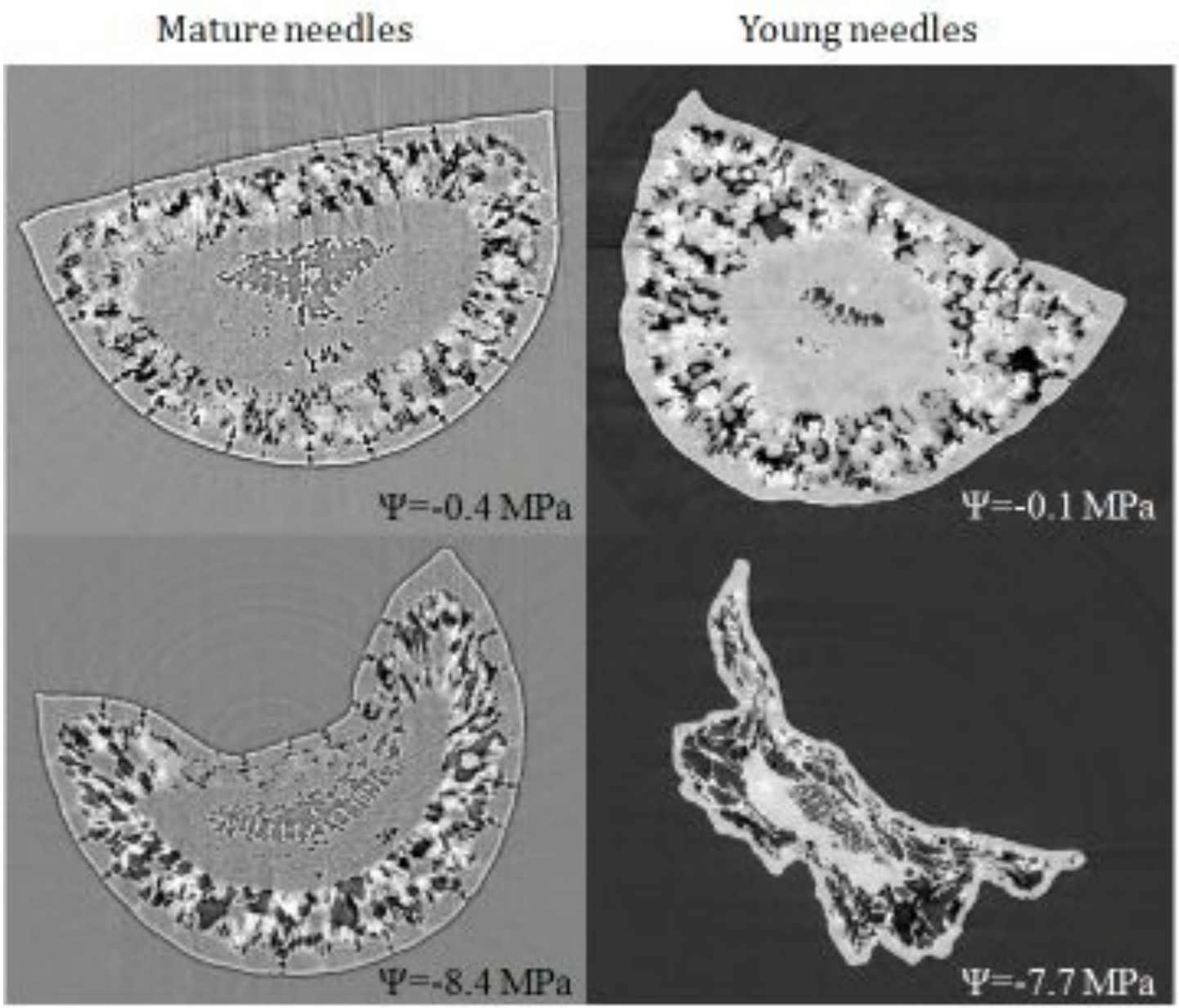
Needle vulnerability to cavitation (*Pinus pinaster*)



Bouche et al in prep

No evidence of collapse contrary to the argument of H. Cochard

Needle vulnerability to cavitation (*Pinus pinaster*)



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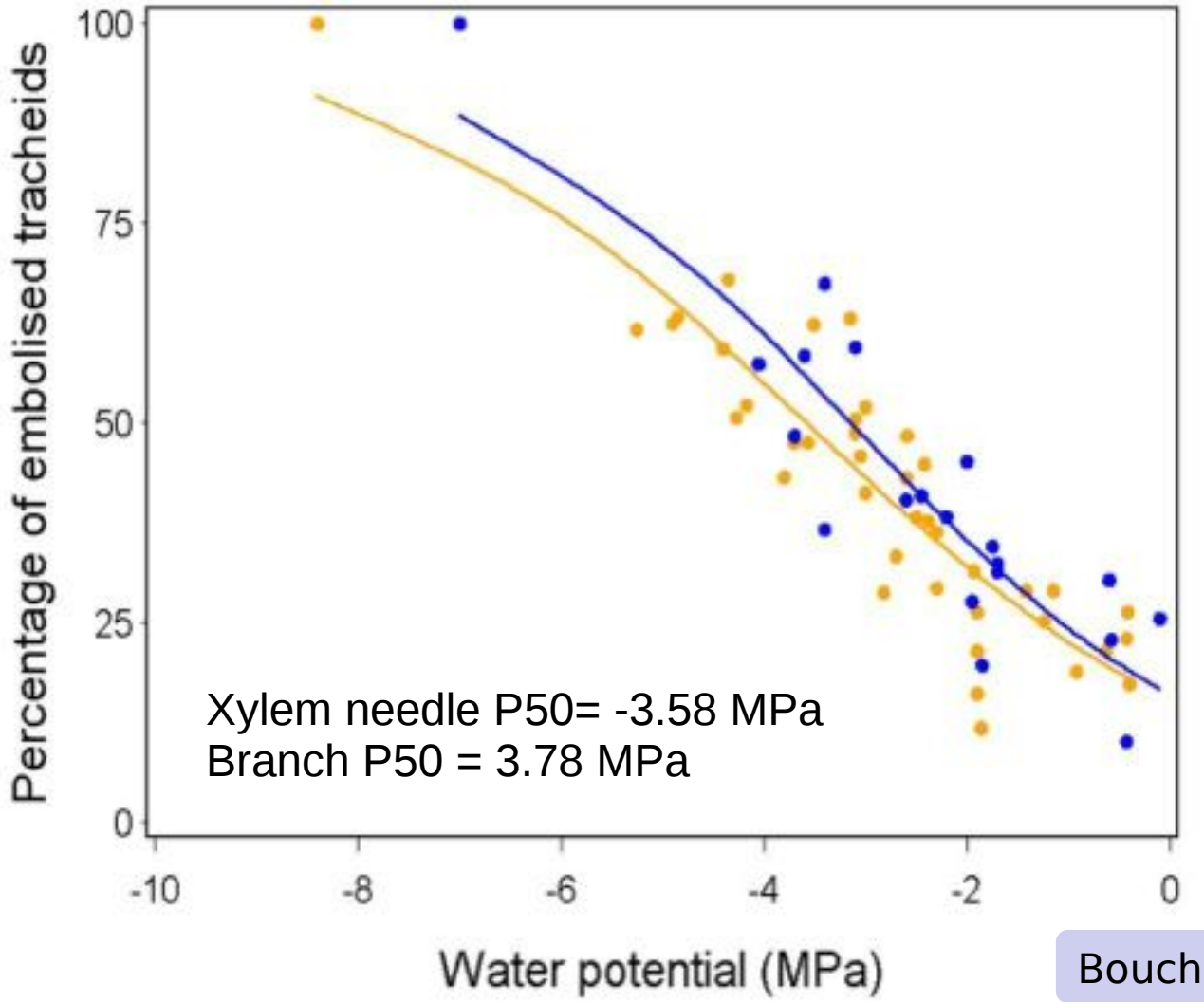


Bouche et al in prep

No evidence of collapse contrary to the argument of H. Cochard

Take home message

Ecophysiology

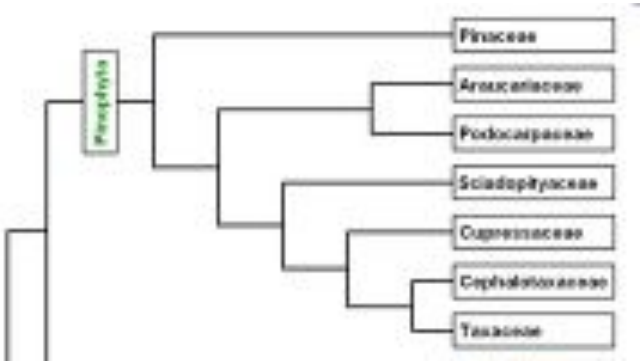
1. Survival: P50 for conifers / P88 for angiosperms

2. Towards an understanding of the mechanism of cavitation in conifers

Seal capillary seeding (torus overlap)

Evolution

3. Biogeography and Macroevolution: Cupressaceae evolved toward a more cavitation resistant xylem



4. Low genetic diversity and phenotypic plasticity for P50