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Tree diversity does not always improve resistance of forest ecosystems to drought

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Damien BONAL
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Biodiversity & Ecosystem functioning



Seed dispersal by birds



Fuel wood



Climate regulation



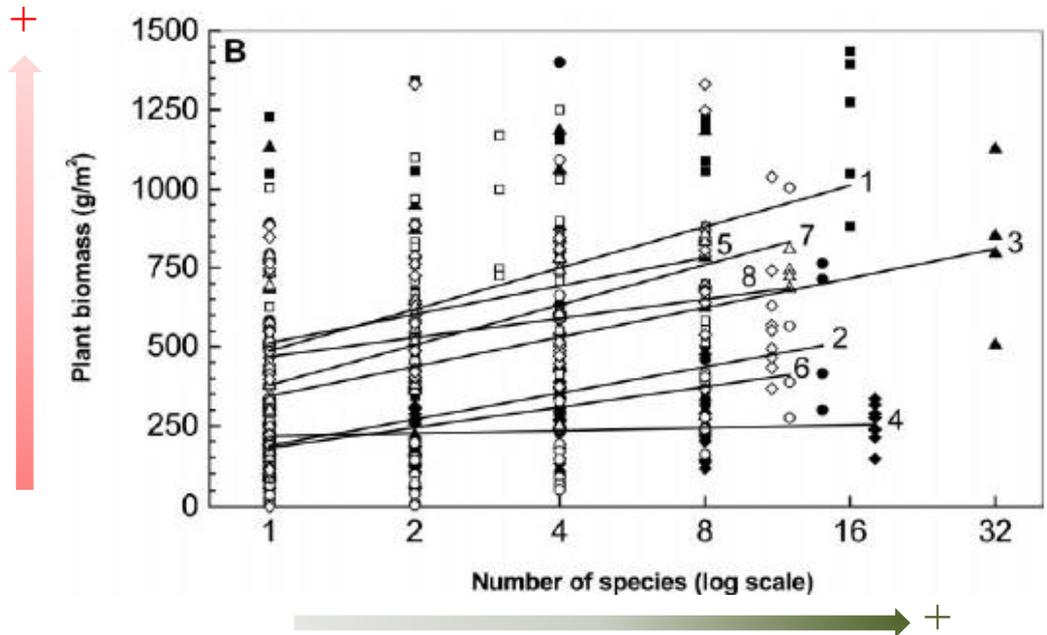
Ecotourism

MEE, 2006

Biodiversity & Ecosystem functioning

Increasing species diversity can lead to important **benefits** for ecosystems

Biomass Production



Loreau *et al.* 2001

Higher biomass production in more diverse ecosystems



Biodiversity & Ecosystem functioning

Increasing species diversity can lead to important **benefits** for ecosystems

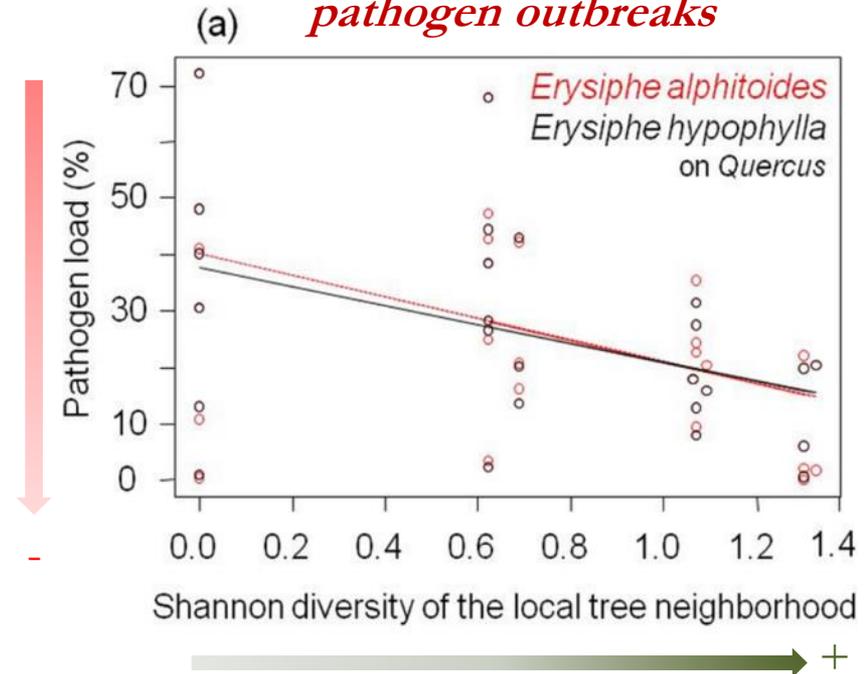


www.worldofstock.com



www.bbc.co.uk

Resistance against pest & pathogen outbreaks

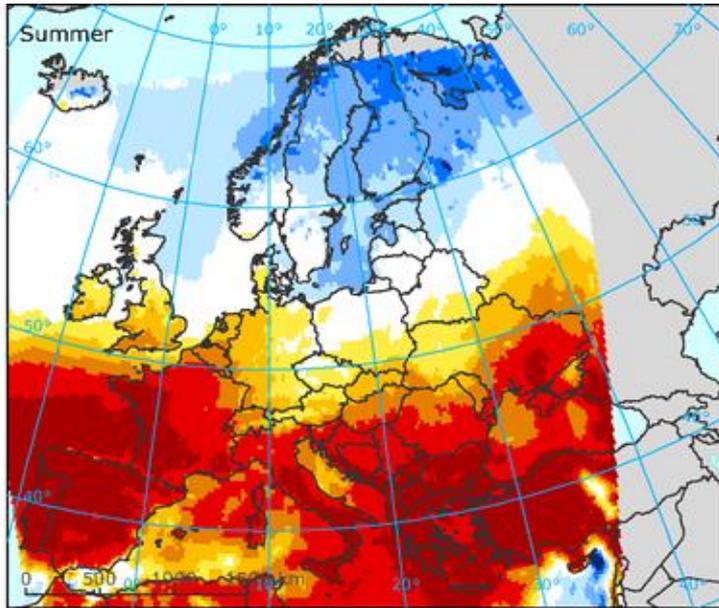


Hantsch *et al.* 2013

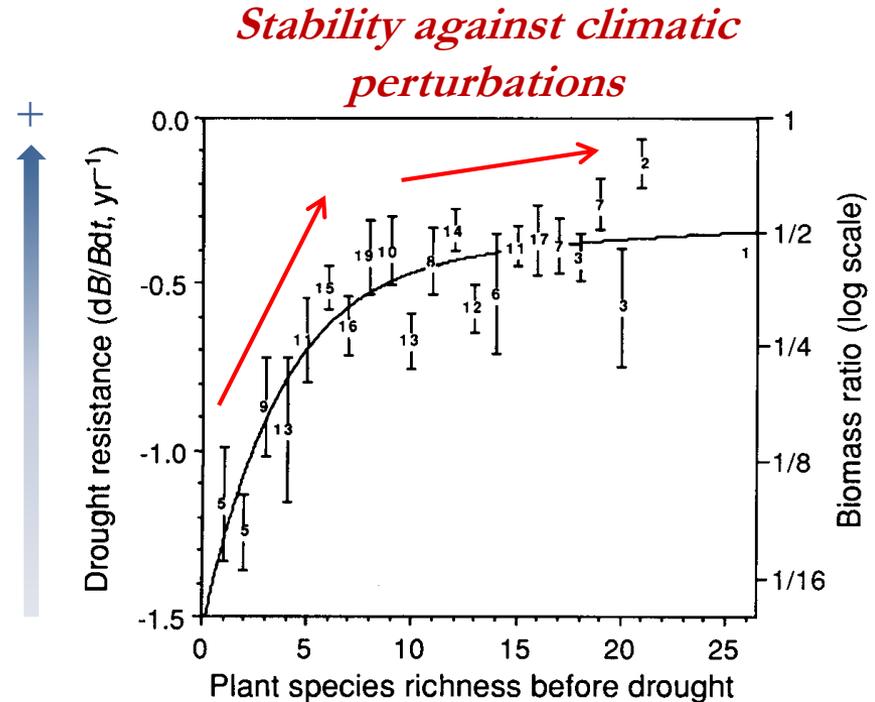
Lower foliar pathogen load in more diverse ecosystems

Biodiversity & Ecosystem functioning

Are more diverse ecosystems **more resistant** to drought?



EEA, 2012



Tilman & Downing 1994

Increasing drought resistance in more diverse communities

Objectives of the study

Test whether higher tree species diversity in forest ecosystems across Europe is associated with less drought exposure



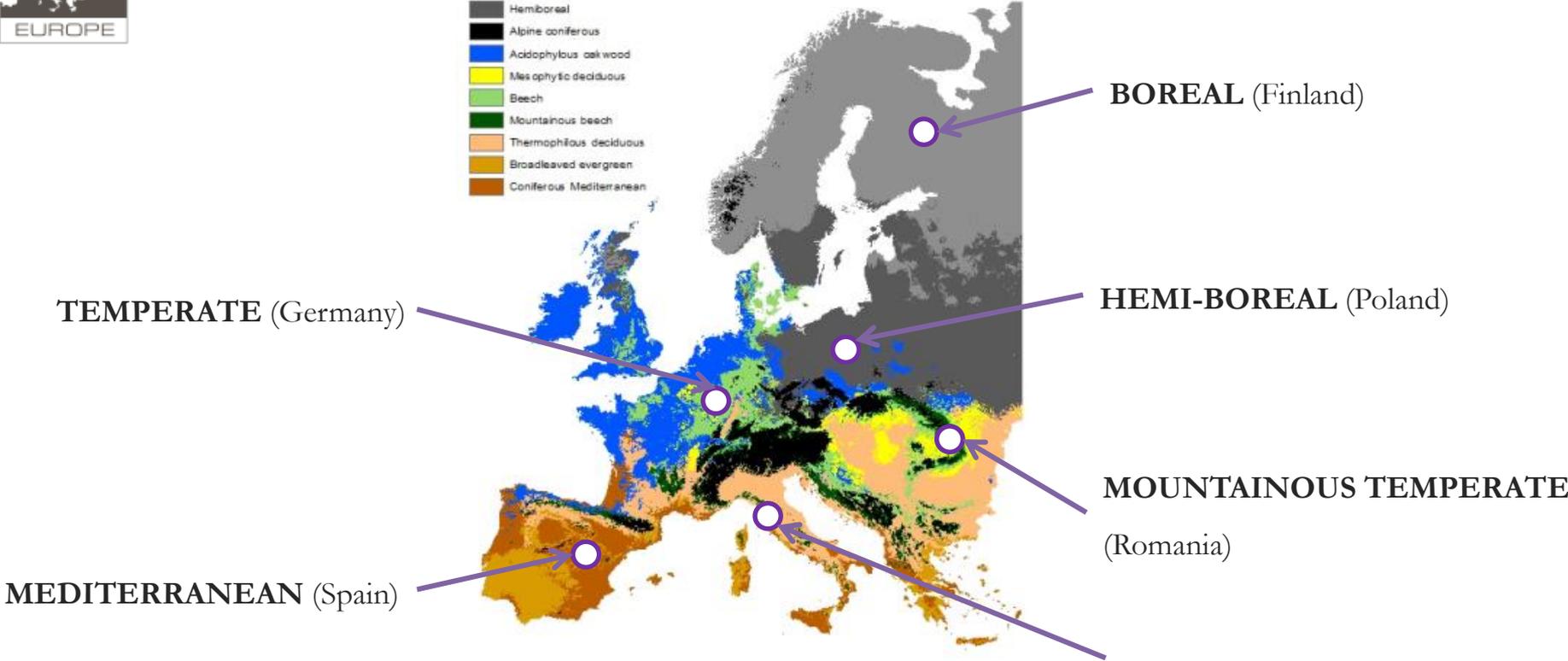
Grossiord C.



Study Sites



6 regions across North - South gradient in Europe to cover the major forest types and climatic conditions

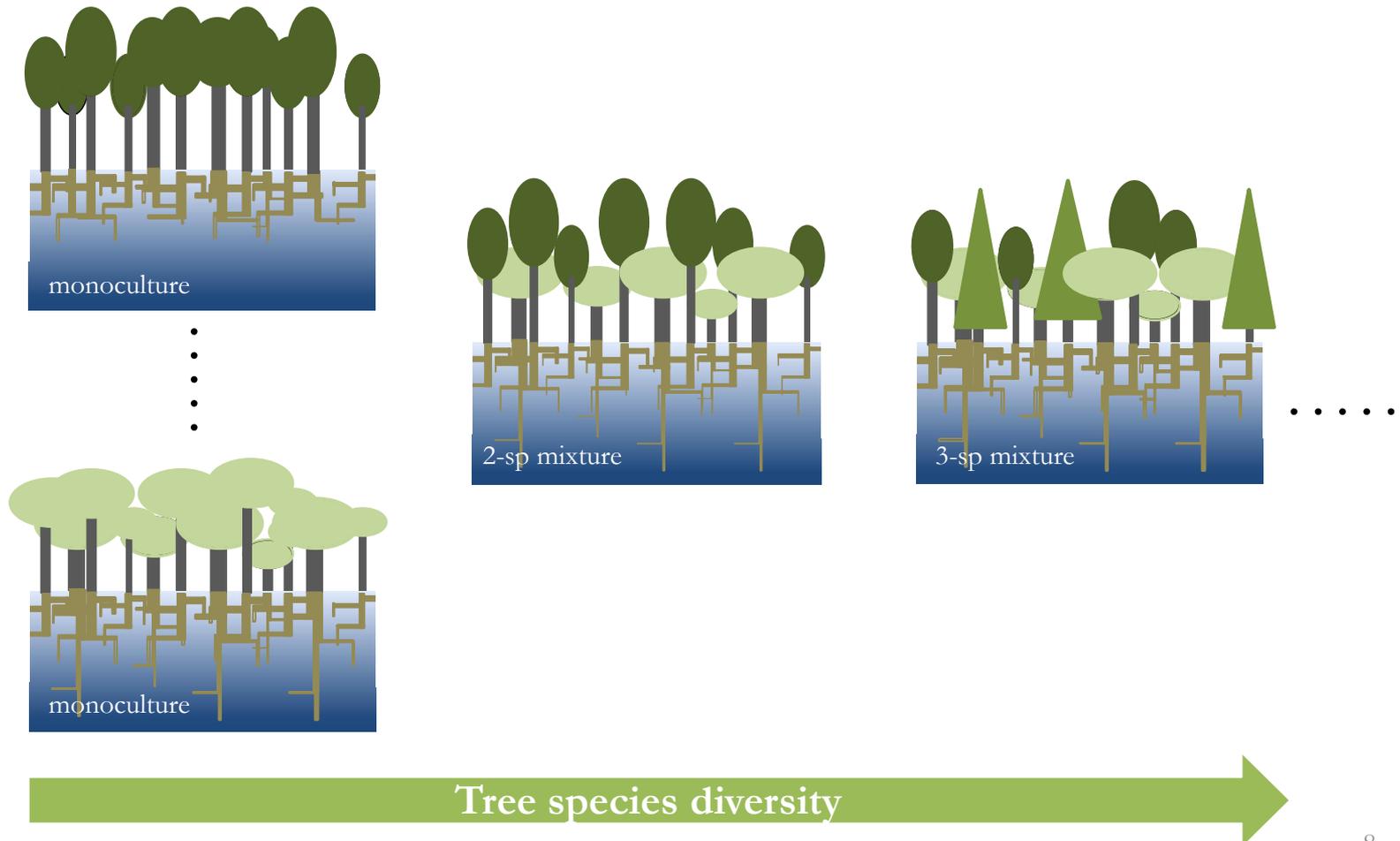


Casalegno et al. 2011

THERMOPHILOUS DECIDUOUS (Italy)

Material and Methods

Comparison of ecosystem functioning for different levels of species mixture (1-5)



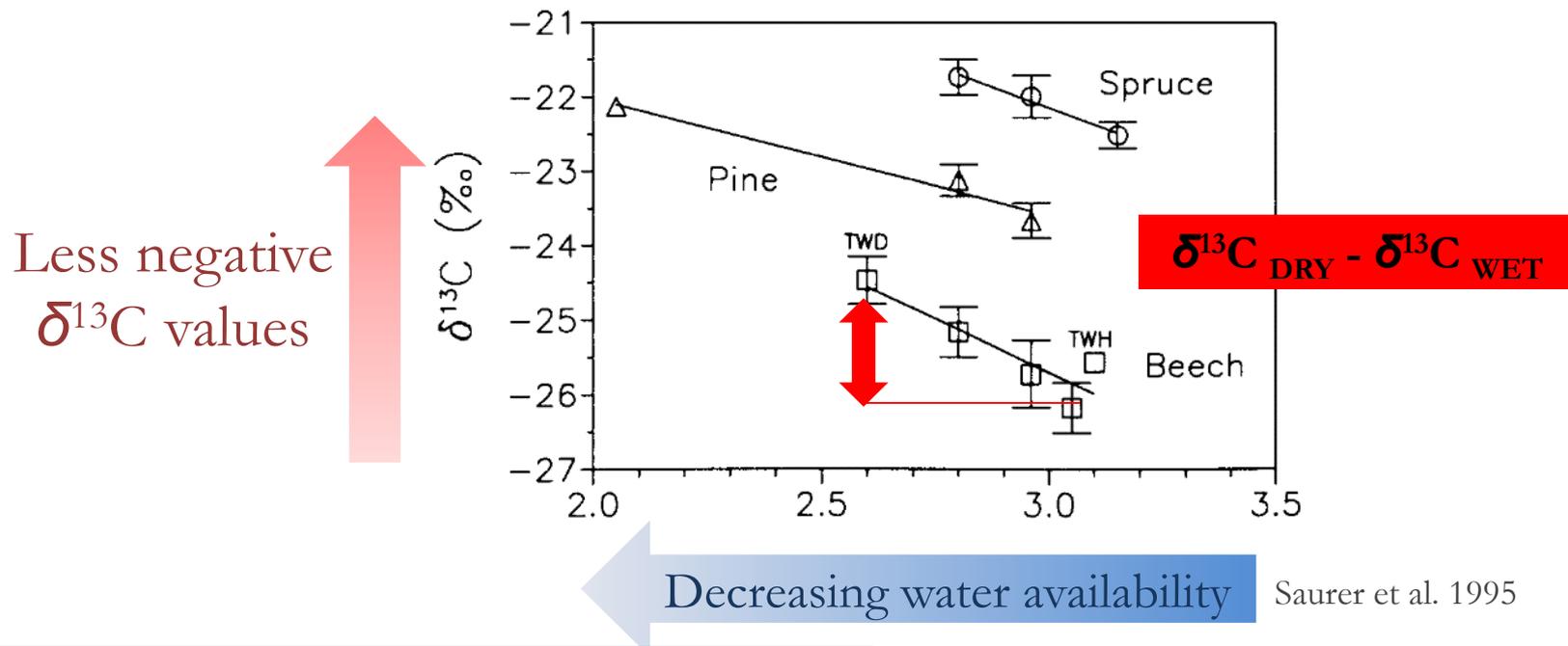
Material and Methods

Comparison of ecosystem functioning for different levels of species mixture (1-5)

- Selection of 25 to 42 stands (30×30m) varying in species richness in each studied region
- Extraction of wood cores from a selection of dominant and co-dominant trees of each species in each stand
- Selection of years (tree rings) with contrasting climatic conditions (**dry** vs. **wet**)
- Analyses of carbon isotope composition ($\delta^{13}\text{C}$) of latewood of each ring
- Calculation of plot-level $\delta^{13}\text{C}$

Material and Methods

- The difference in plot-level $\delta^{13}\text{C}$ between the **DRY** and the **WET** year can be used as a proxy of drought exposure



If difference in $\delta^{13}\text{C}$ is high, low resistance

If difference in $\delta^{13}\text{C}$ is low, high resistance

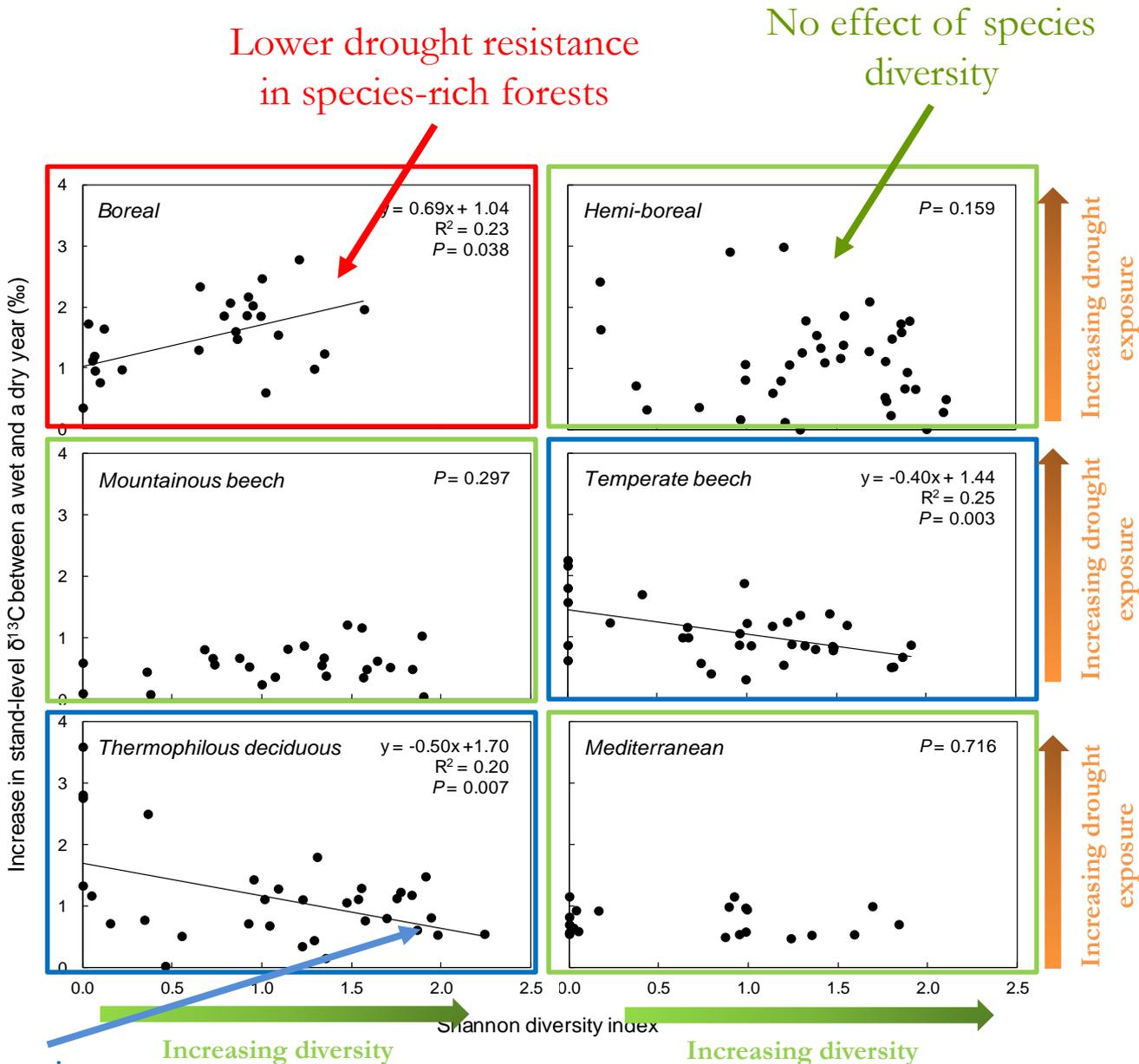


Tree diversity does not always improve resistance of forest ecosystems to drought

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Results



Higher drought resistance in species-rich forests

Results

Tree species diversity effects seem partially dependent on **climatic conditions**

Rare events and low intensity of drought
Negative effects

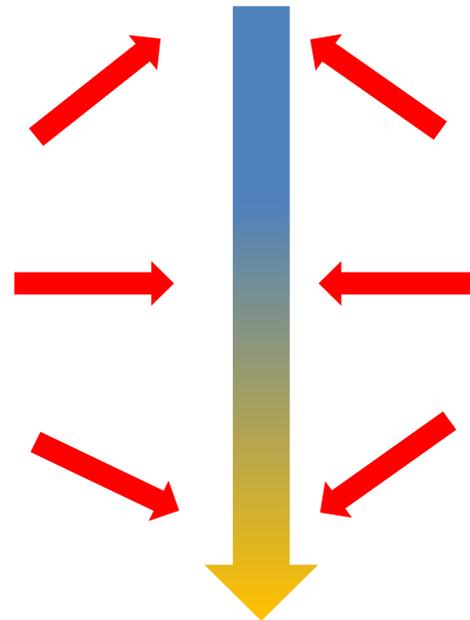
Biotic conditions

(e.g. tree species composition)

Abiotic conditions

(e.g. soil type)

Frequent events and high intensity of drought
Positive effects



Conclusions

- Tree species diversity influences the functioning of forest ecosystems in terms of water and carbon acquisition and use
- More diverse forests may be more resistant to soil drought than pure ones, but not necessarily
- Favoring mixed forest ecosystems could be preferred in certain regions, not only to preserve biodiversity or sustain productivity in the context of climate changes, but also to delay the negative effect of drought

Thanks for your attention

