# Potential role of minor tree species to adapt Central European forests to climate change – and what we may do with them

Jörg Kunz, Patrick Pyttel, Jürgen Bauhus

Chair of Silviculture

University of Freiburg

UNI FREIBURG

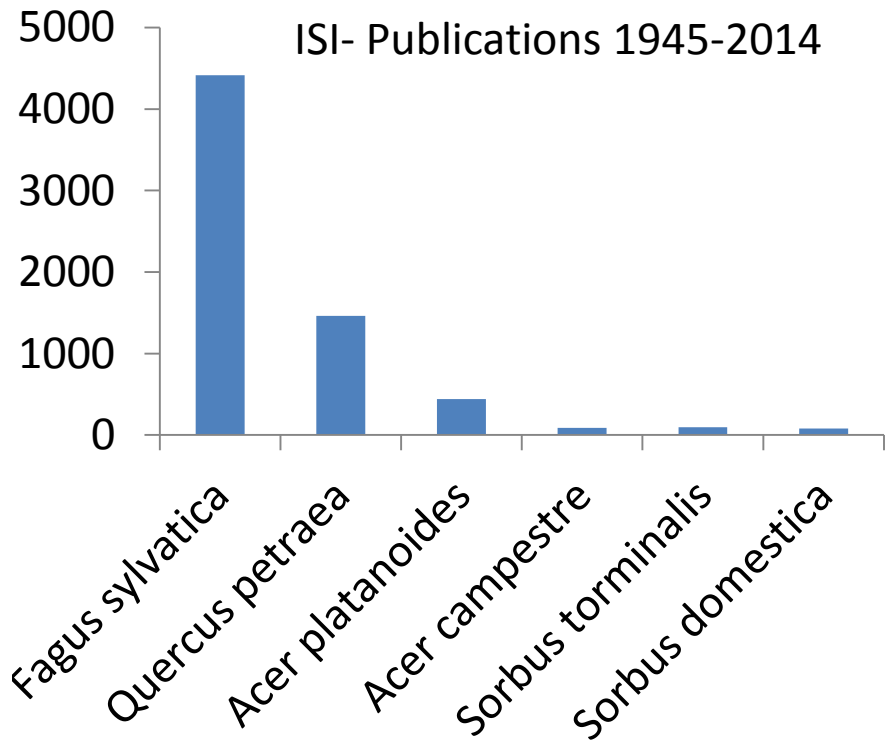
# Content

- Minor tree species – what are they?
- Interest in minor tree species
- Suitability of minor tree species for dry conditions
- Silvicultural potential of minor tree species
- Research needs to increase use of minor tree species in forestry
- Outlook – ongoing activities

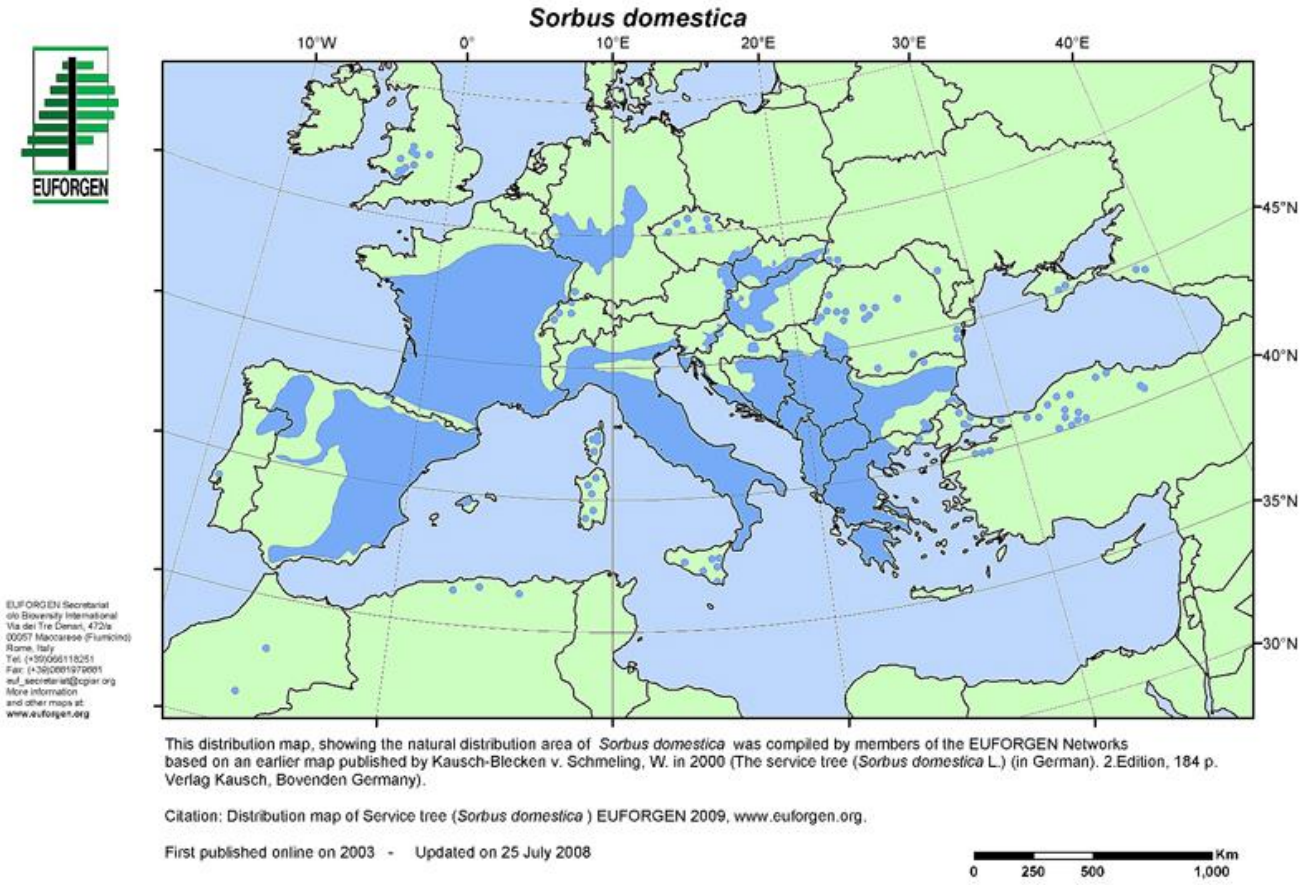
# What are minor tree species?

- No consistent definition of this term

- Percentage of forest component across Europe (Hemery 2008)
  - *Acer campestre* 0.04 %
  - *Acer platanoides* 0.34 %
  - *Sorbus torminalis* 0.02 %
  - *Sorbus domestica* 0.01 %



# What are minor tree species?




- Potentially large distribution area
- Ecological niche is only a fraction of the physiological niche

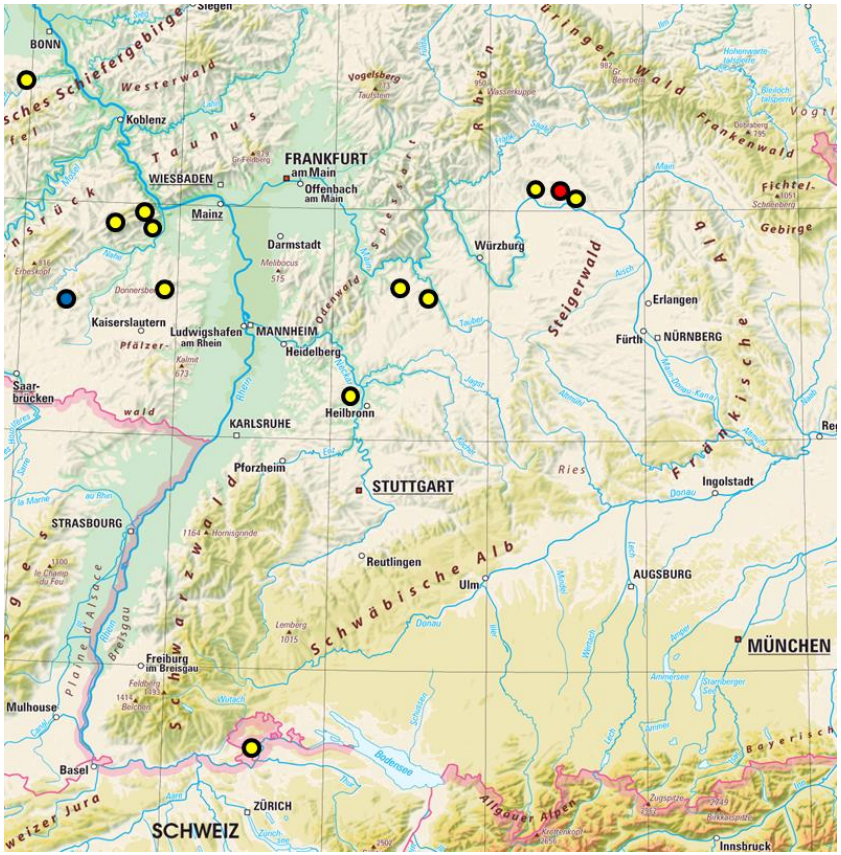
# Interest in minor tree species

- Environmental: biodiversity
- Silvicultural: increasing options for mixed species forests, drought tolerant species (for the extreme end of adaptation?)
- Economical: highly valuable timber, use of fruits (e. g. *Sorbus*)
- Aesthetics, cultural: colourful flowers and autumn leaves

Foto: A. Storrer

# Suitability of minor tree species for dry and warm conditions

Research area

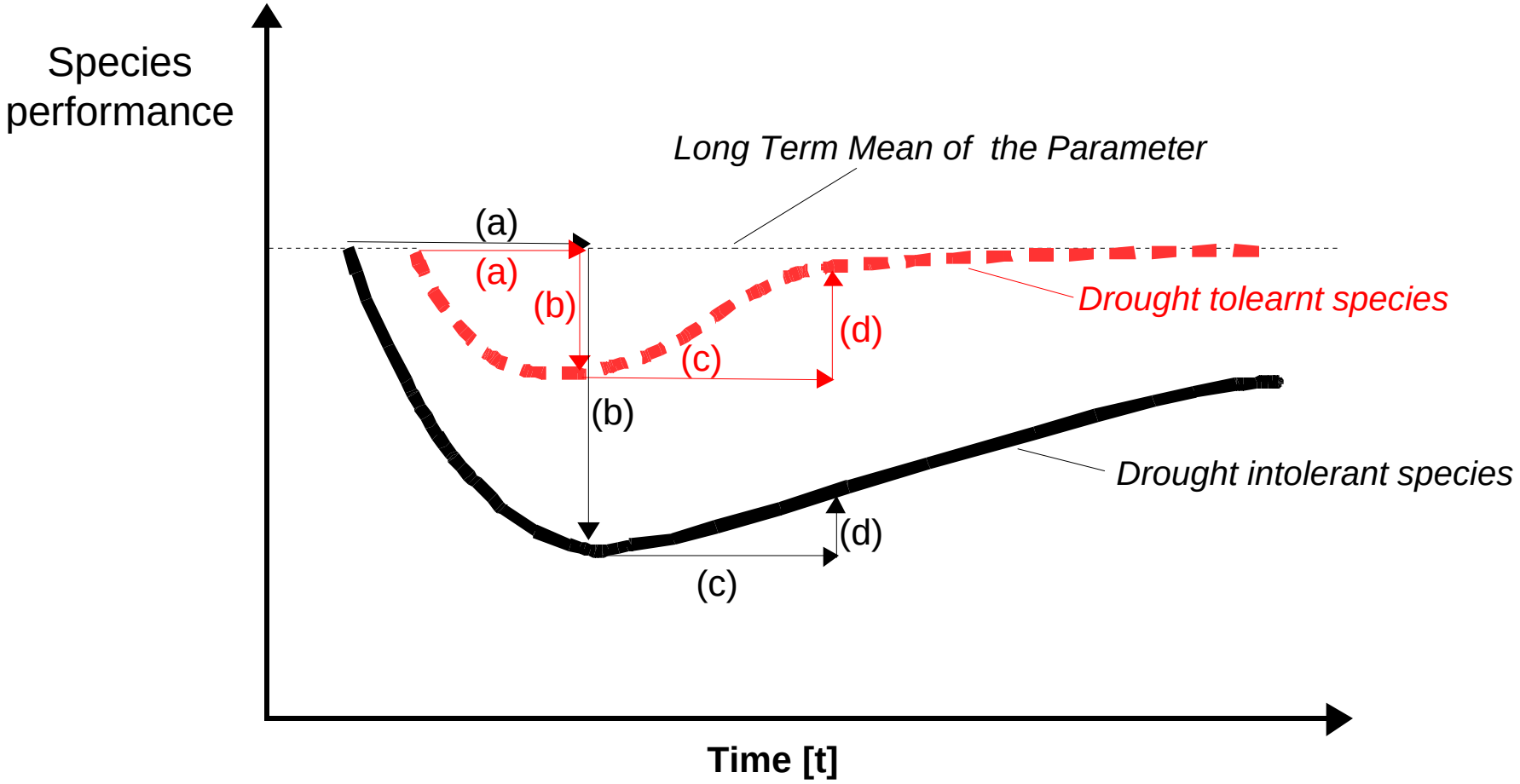



How does the drought response of rare species compare to that of more common species?

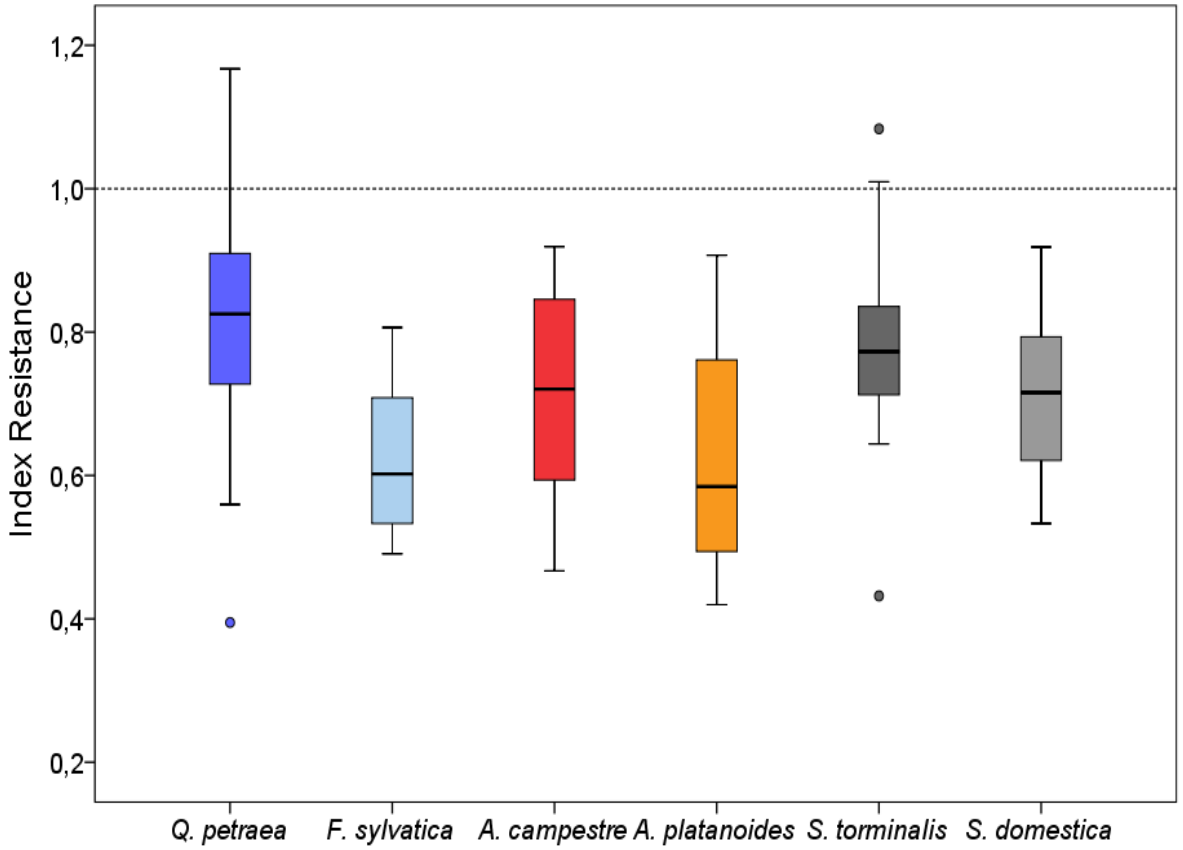
Drought response:

Growth of established trees and physiological performance of seedlings

# Underlying approach to quantify drought tolerance

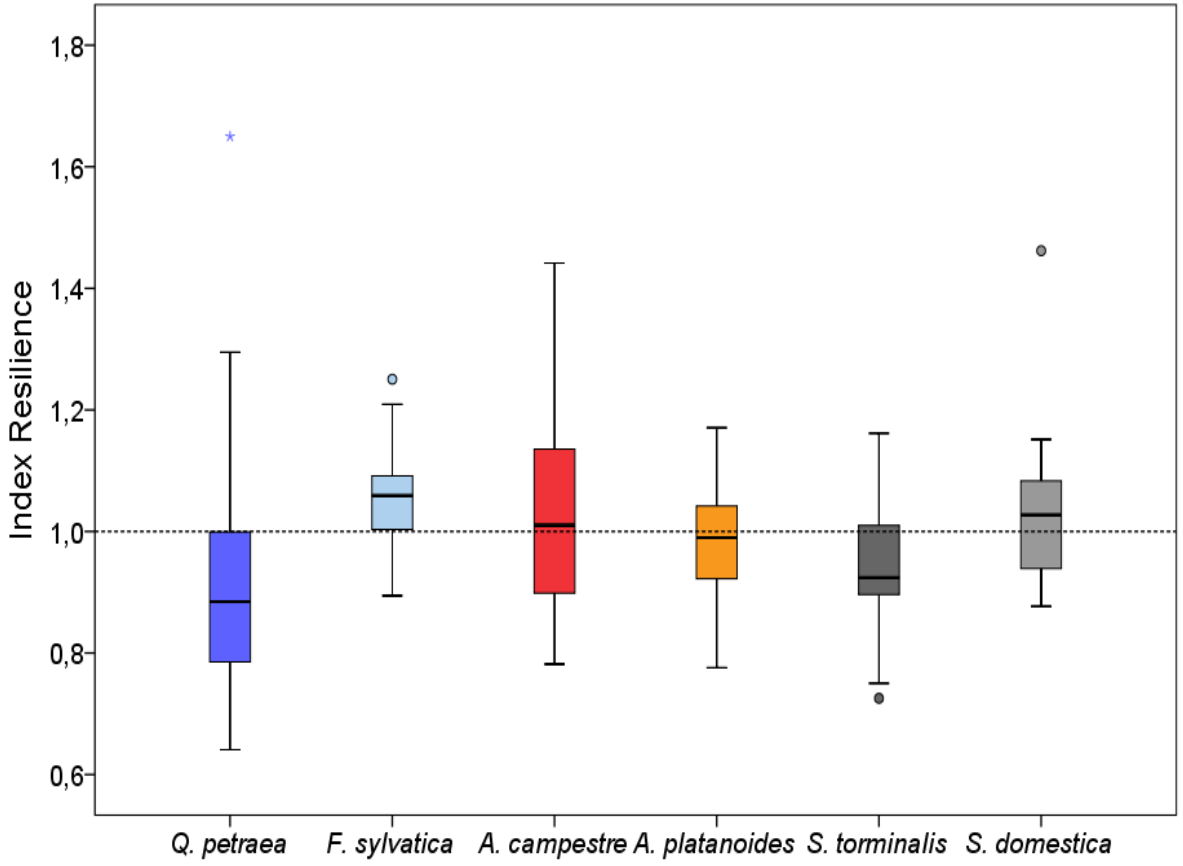


# Drought resistance of mature trees



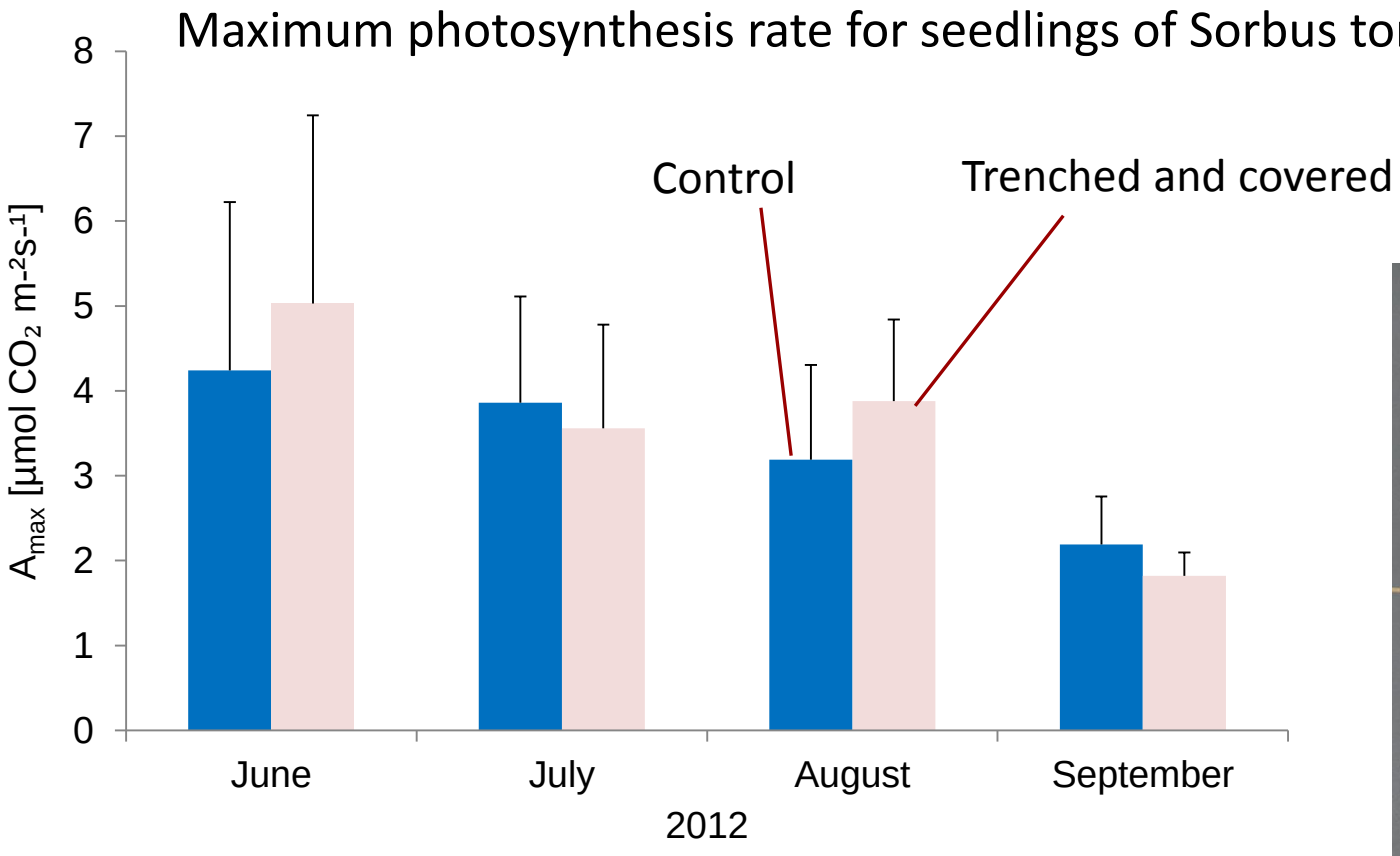

**Mean radial growth** of the 5 years before the respective drought year (1947, 1976, 2003) was compared to the radial growth during the drought year. A value of 1 indicates no growth depression.

# Drought resilience of mature trees



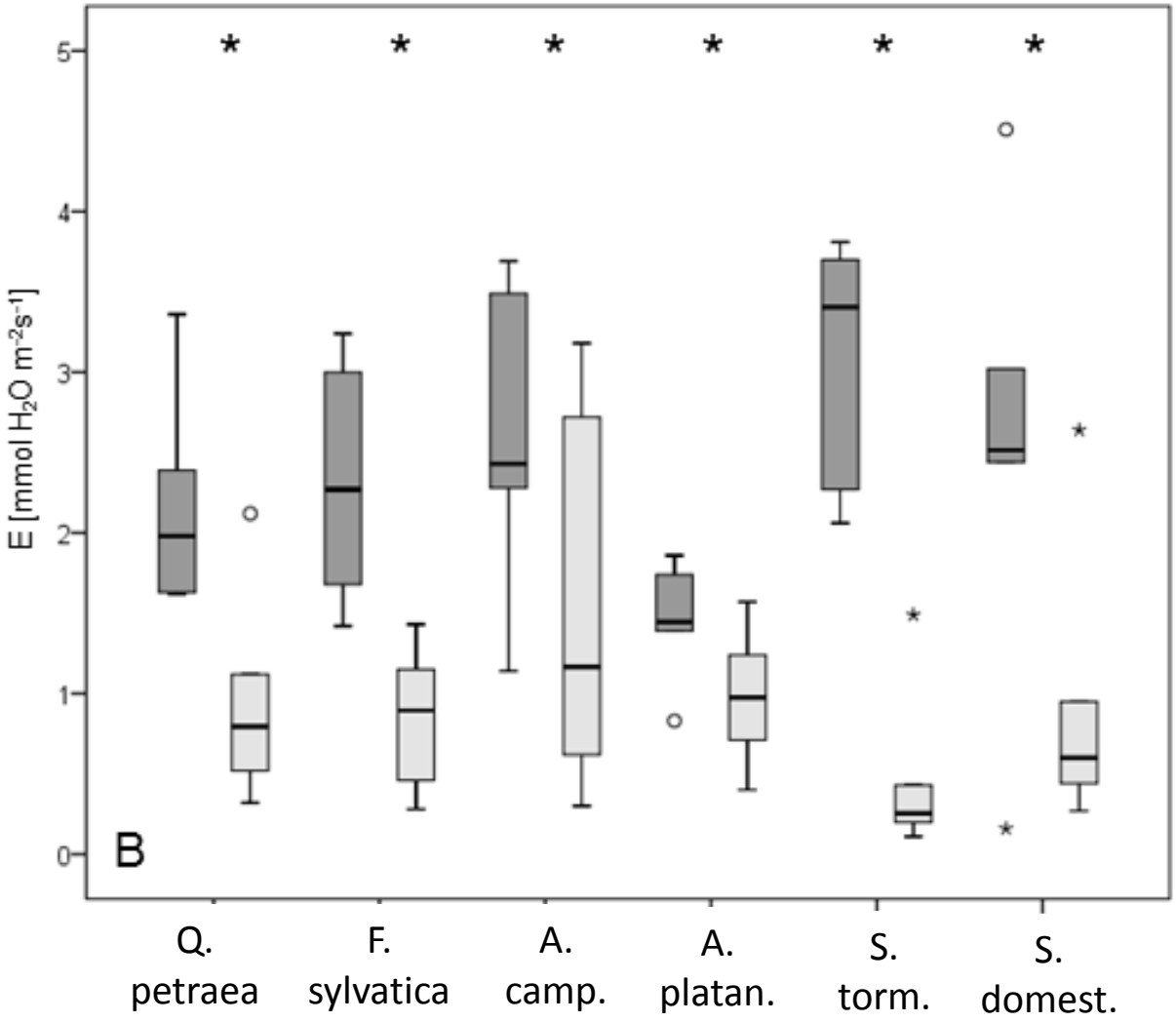

**Mean radial growth** of the 5 years after the respective drought year (1947, 1976, 2003) was compared to the radial growth before the drought year. A value below 1 indicates no full recovery.

# Drought resistance of seedlings in the field: responses to trenching and covering



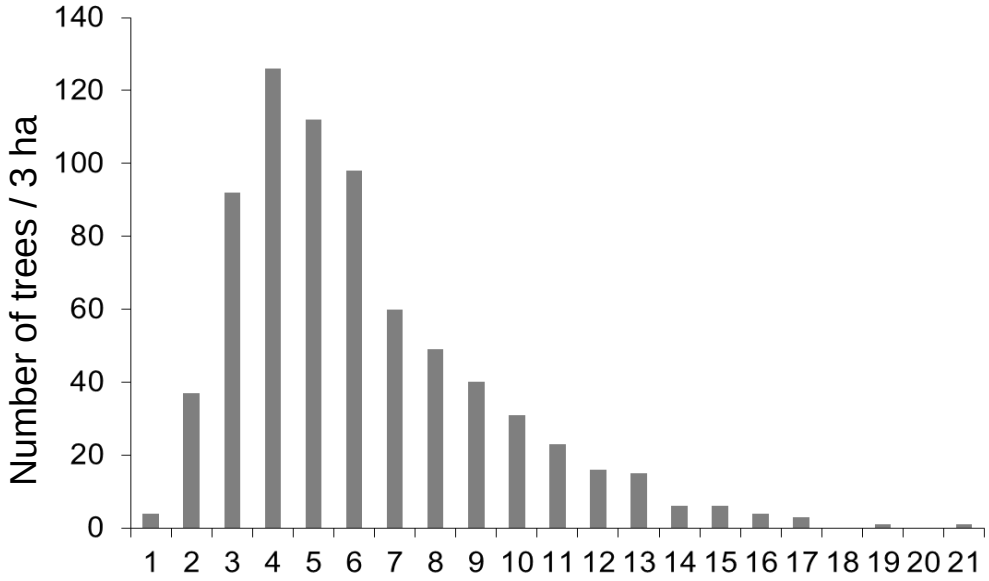

S. torminalis root sucker

# Drought resistance of seedlings




**Maximum transpiration rate** for seedlings of the control (dark grey box plots) and the non-irrigated group (light grey box plots) after 32 days without watering

# Are some rare species reliant on historical disturbance regimes?




Trees (2013) 27:1609–1619
DOI 10.1007/s00468-013-0908-7

ORIGINAL PAPER

**Growth, regeneration and shade tolerance of the Wild Service Tree (*Sorbus torminalis* (L.) Crantz) in aged oak coppice forests**

Patrick Pyttel · Jörg Kunz · Jürgen Bauhus

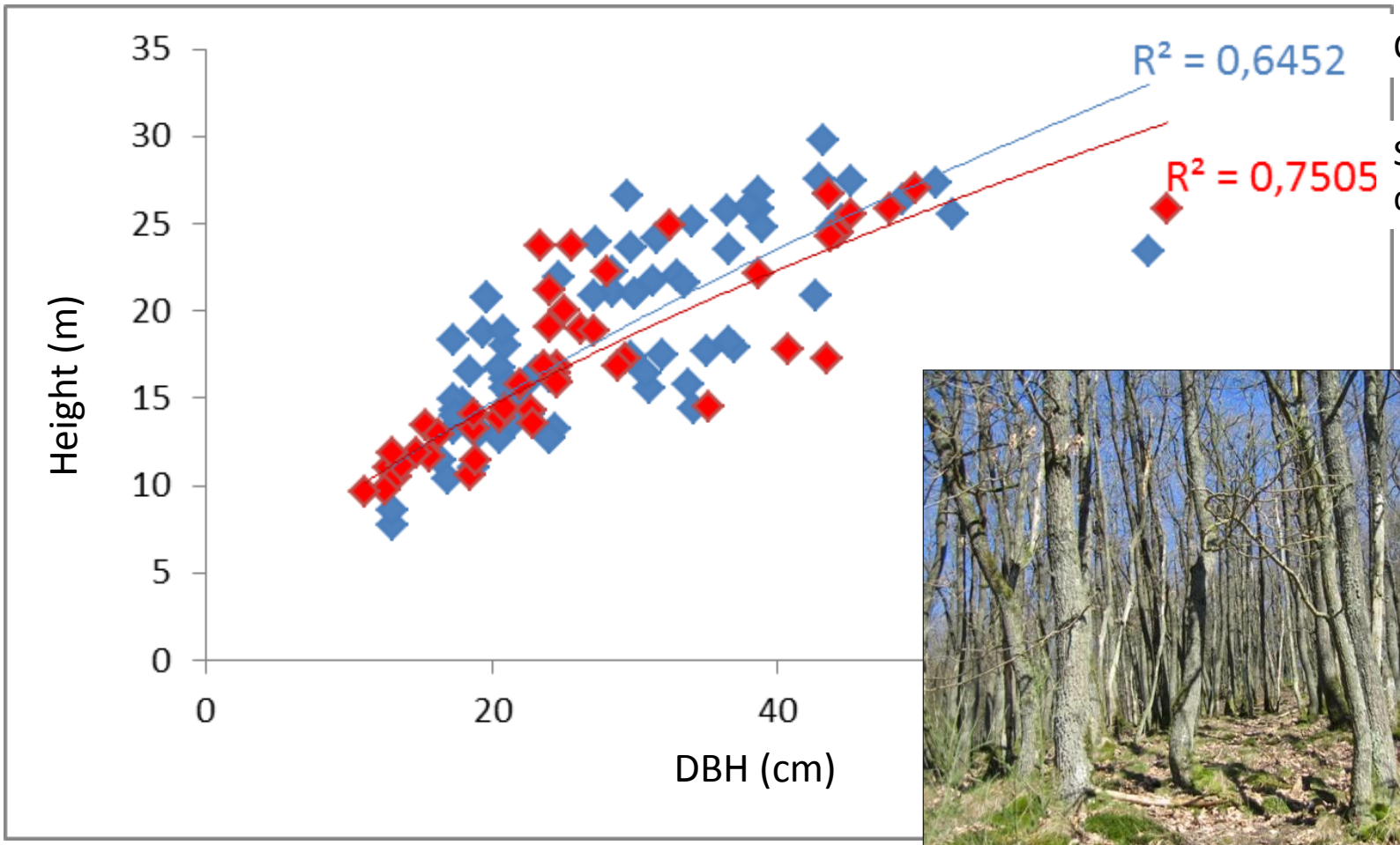
Frequency of **S. torminalis** in 3 ha of former (ca. 80 yr old) coppice forest dominated by Quercus petraea. N= 241 /ha

# Are some rare species reliant on historical disturbance regimes?


Age differences between **S. domestica and neighbouring Q. petraea** in former coppice forests in southwest Germany
N= 71

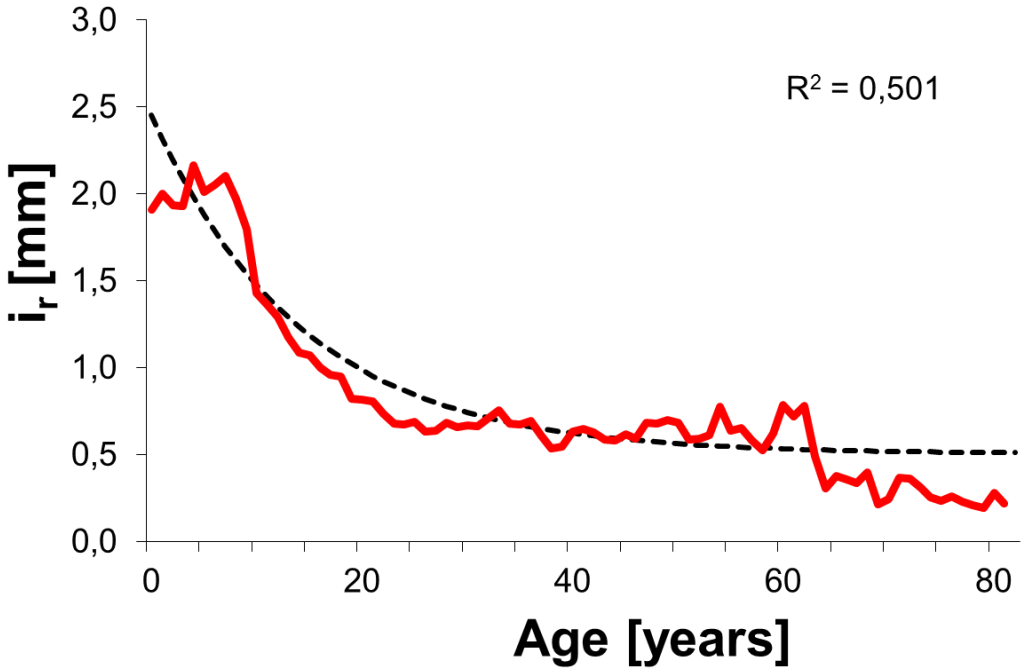
younger than neighbouring oaks ← → older than neighbouring oaks

# Comparison of height growth rates




# Growth rates of suppressed S. torminalis

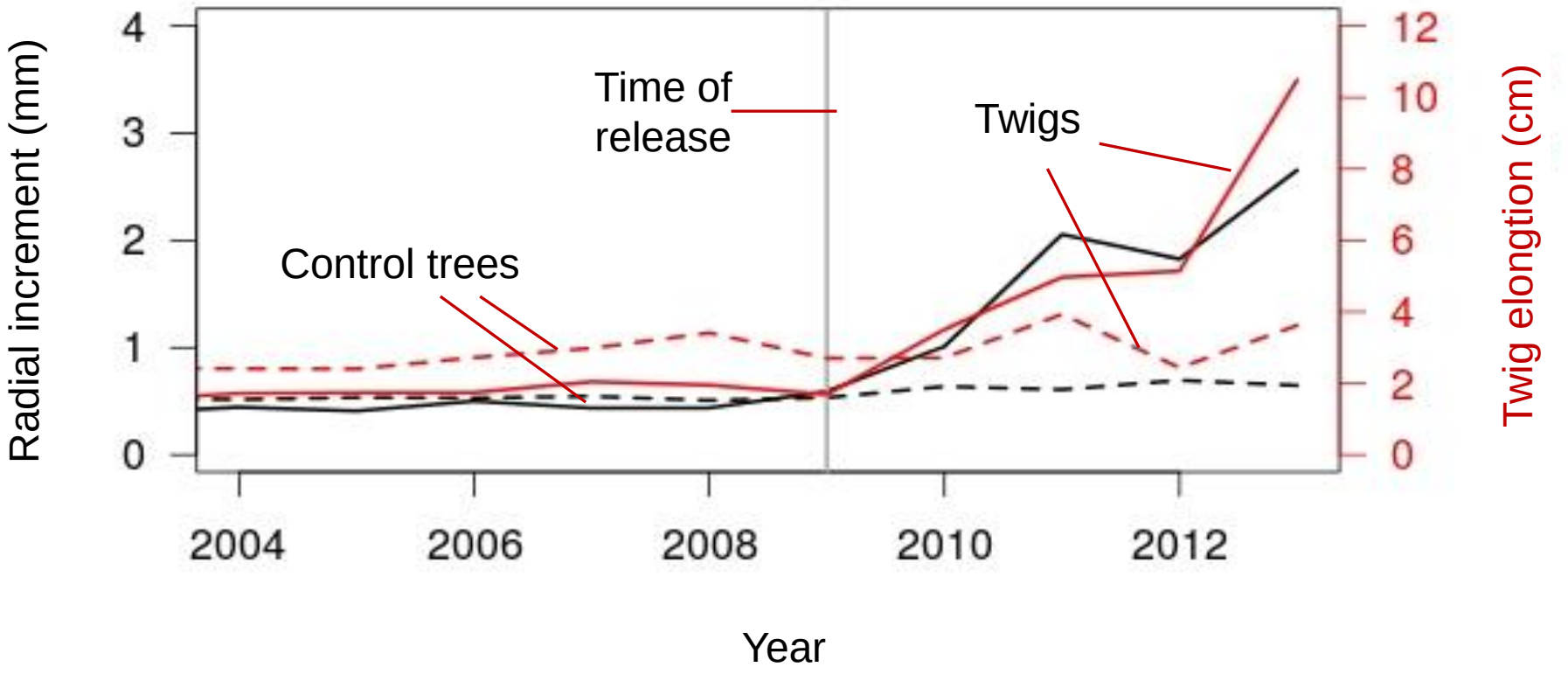
Can we still work with these „forgotten“ trees?



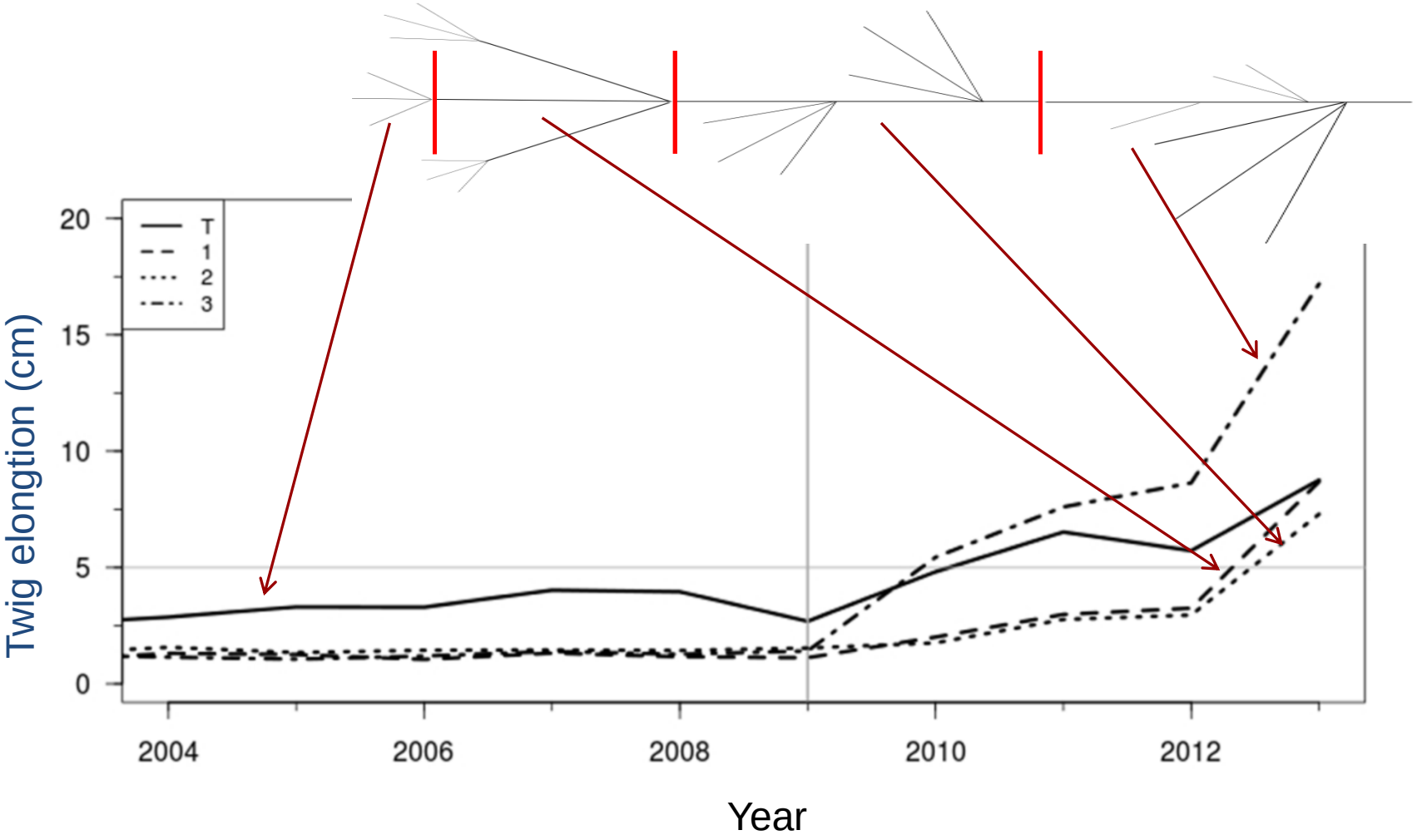

Diameter increment of suppressed *S. torminalis*. Solid line shows mean rates; dashed line represents regression curve. N= 20.

# Growth rates of released S. torminalis

Average radial increment at 1.3 m tree height. Crown expansion reconstructed from twig analysis (N=40).



# Growth rates of released S. torminalis



# Summary

- The rare tree species Acer campester, A. platanoides, Sorbus domestica, and S. torminalis appear to be tolerant to drought; using different “strategies”.
- Whereas S. domestica appears to depend on coppicing (or heavy thinning) for survival, S. torminalis can persist in the shade of oaks.
- S. torminalis is capable to respond to release from competition, predominately through elongation of interior branches of crowns.

# Further research

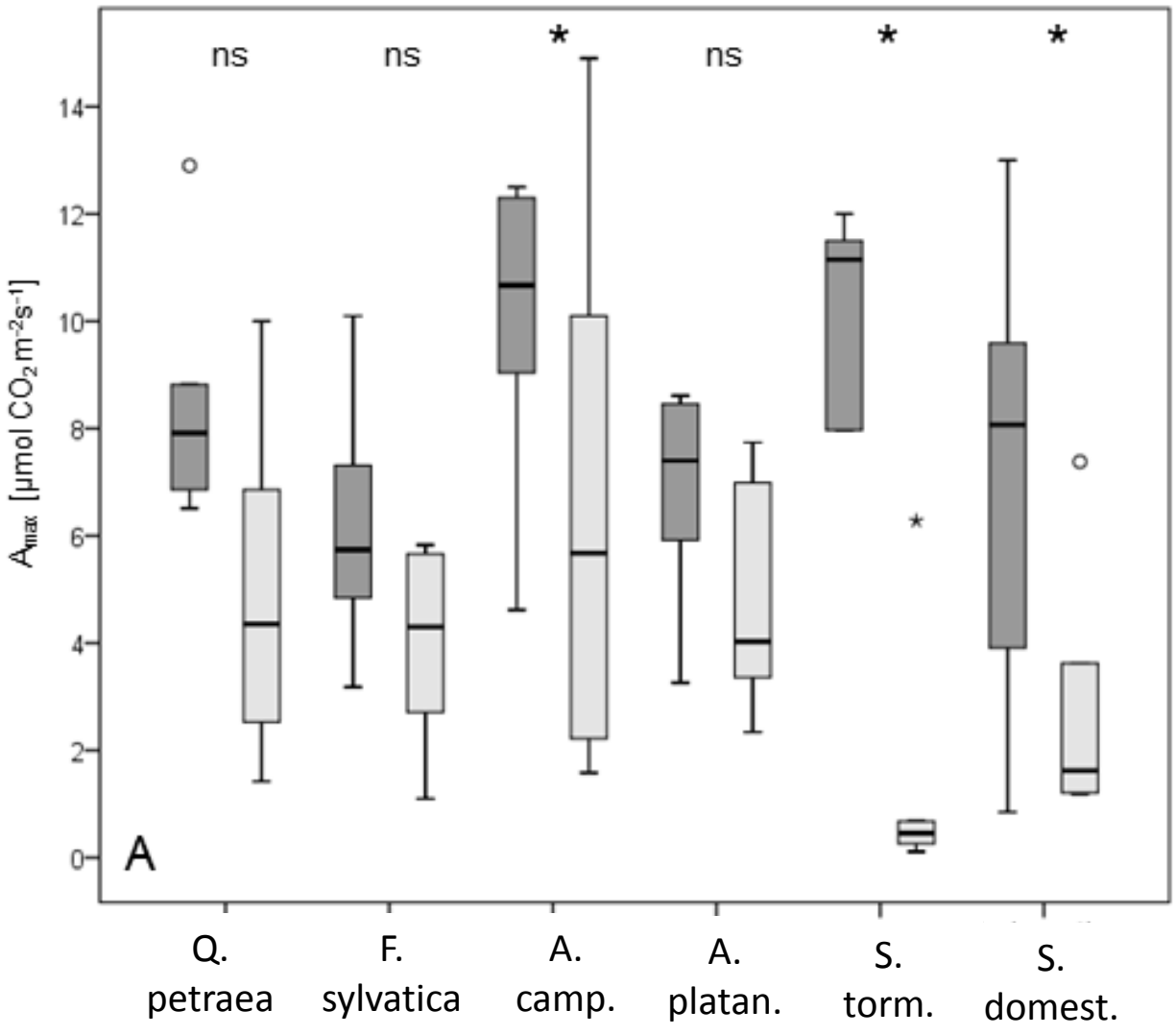
- Physiology, ecology and genetic diversity of species is still little explored
- Sources of planting material are often unknown, no selection rules for seed trees
- No basic silvicultural concept for minor tree species exists: regeneration, thinning (in mixtures), pruning
- Identify areas where rare species occur as “legacies” of abandoned forest/land management systems
- Climate change motivated research may be a rare opportunity to study these species

# Ongoing activities

- Long-term research on permanent experimental sites
- SILVITI: The potential of rare and drought-tolerant tree species for the afforestation of former vineyards

# Thank you for listening!

# Drought resistance of seedlings




**Maximum photosynthesis rates** for seedlings of the control (dark grey box plots) and the non-irrigated group (light grey box plots) after 32 days without watering