Topic: 1. Climate change impact of coniferous forests
Abstract No. 0077

Genetic control over growth sensitivity of Scots pine *Pinus sylvestris* L. across edaphic gradient under hemiboreal conditions

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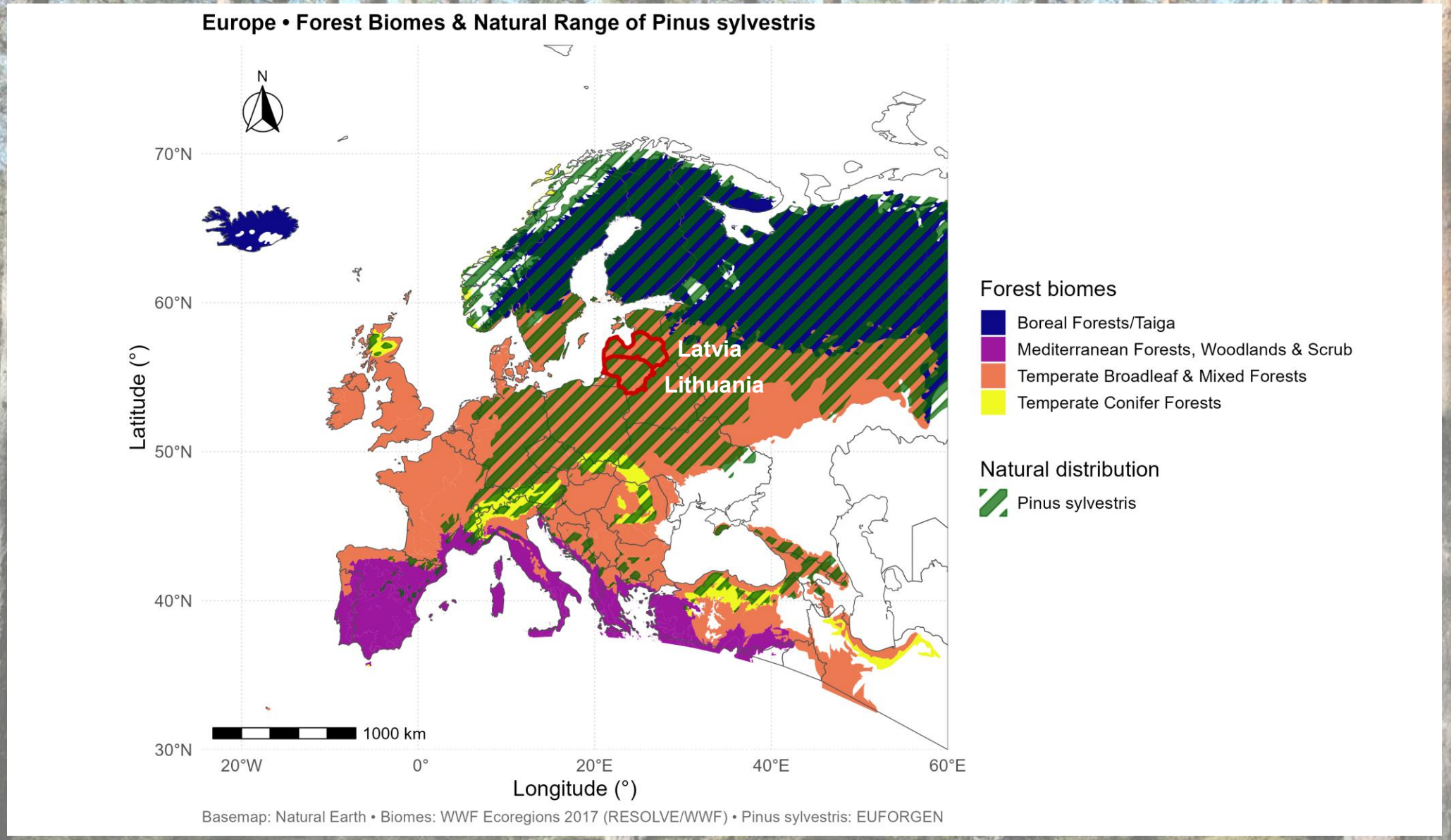
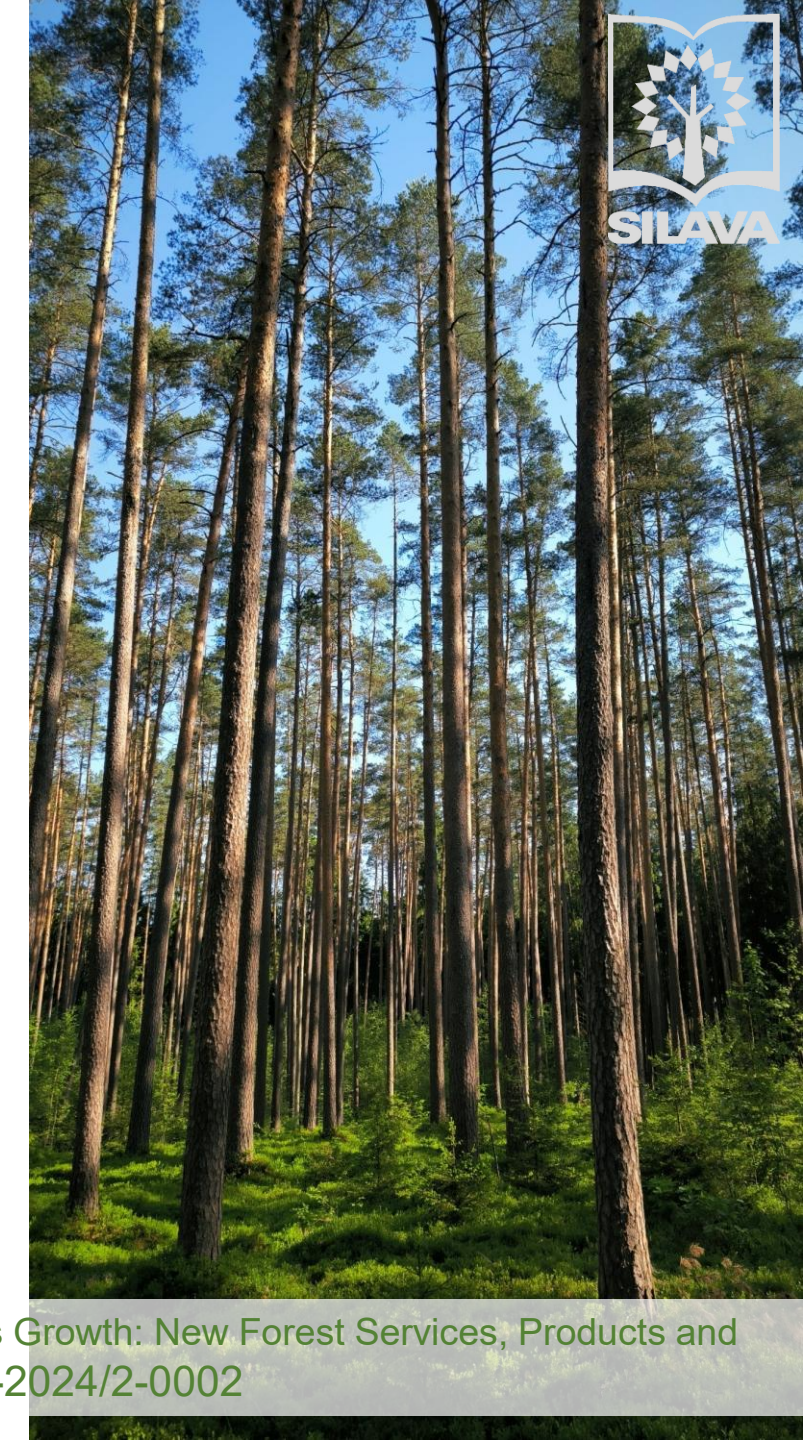
Scots pine *Pinus sylvestris* L.: background



Background

- Scots pine *Pinus sylvestris* L. = key species in Nordic/Baltic forestry
- Active tree breeding, e.g. 100% of planting material in Latvia genetically improved (from seed orchards)
- Long-term breeding programs (especially, in Nordic/Baltic region) since the middle of 20th century → 10 – 30 % gain in growth traits



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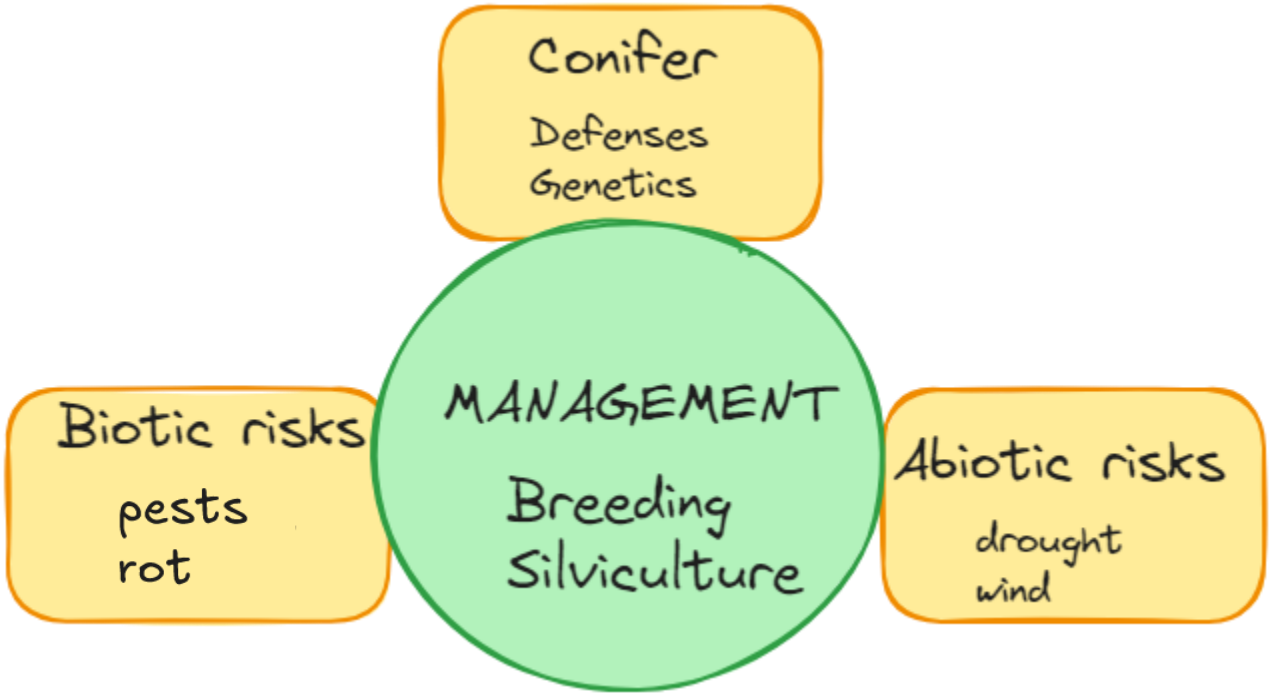
Tree breeding in the context of climate change

- Optimal management
- Improved resistance (directly or indirectly)
- Genetic control of climate-sensitivity

selected, well-adapted (for potential future climate) genotypes

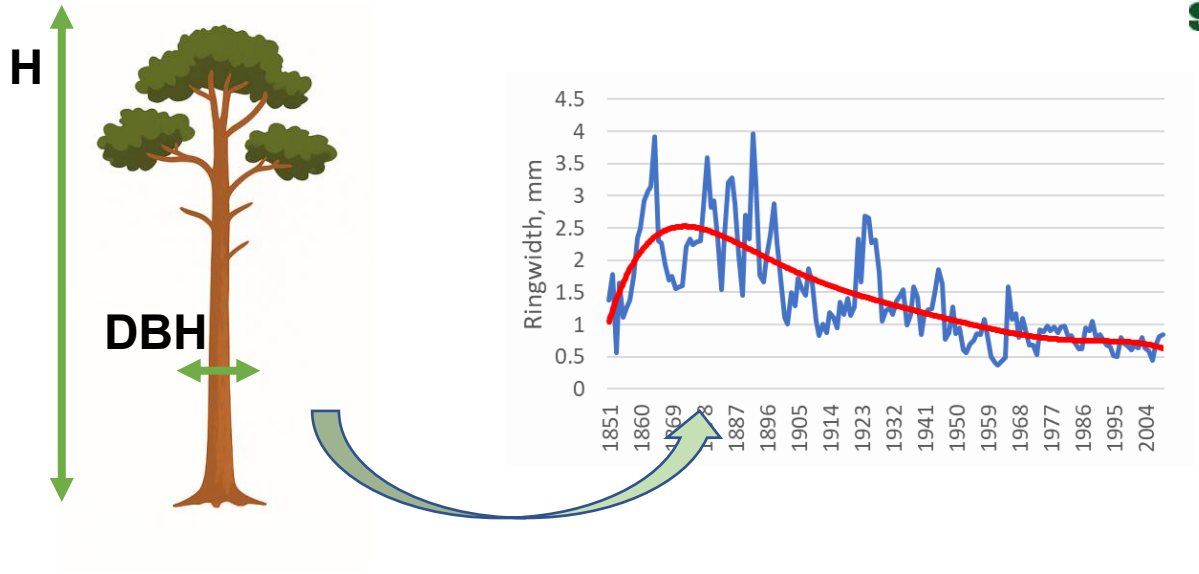


Mageroy et al. (2023)
https://doi.org/10.1007/s40725-023-00201-5

Rationale

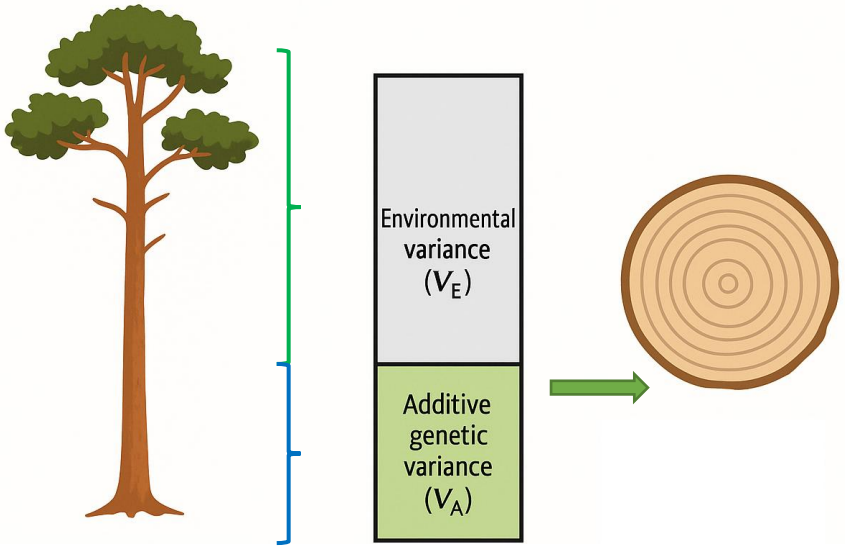
•Traditional breeding focus: growth & stem quality traits

- past-condition traits → less informative for future climates
- Increment as an integral of environmental influences
- Increment and its sensitivity – compatibility of genotype and environment



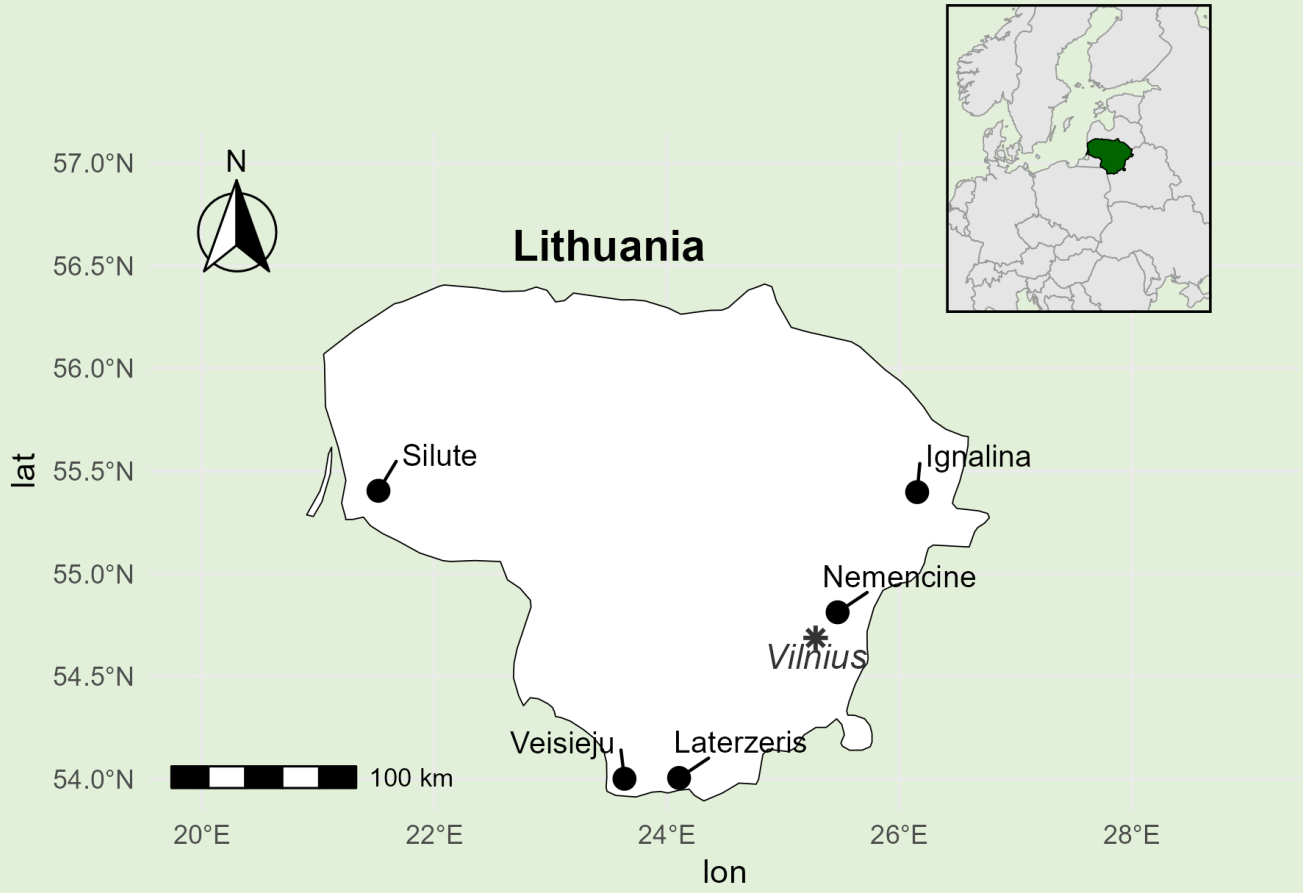
heritability $h^2 = \frac{V_A}{V_P}$

phenotypic variance $V_P = V_A + V_E$



Study sites

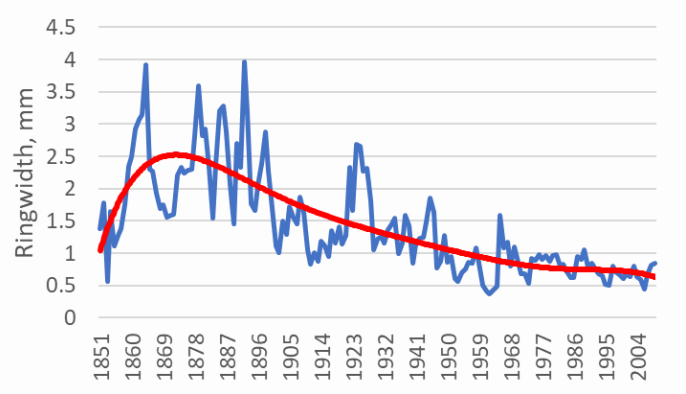
- 5 open-pollinated Scots pine progeny trials
- Established in 1983, initial spacing 1.5 x 1.5 m
- 140 families from 7 populations (20 from each), planted in randomized 10-tree plots in 5 replications.

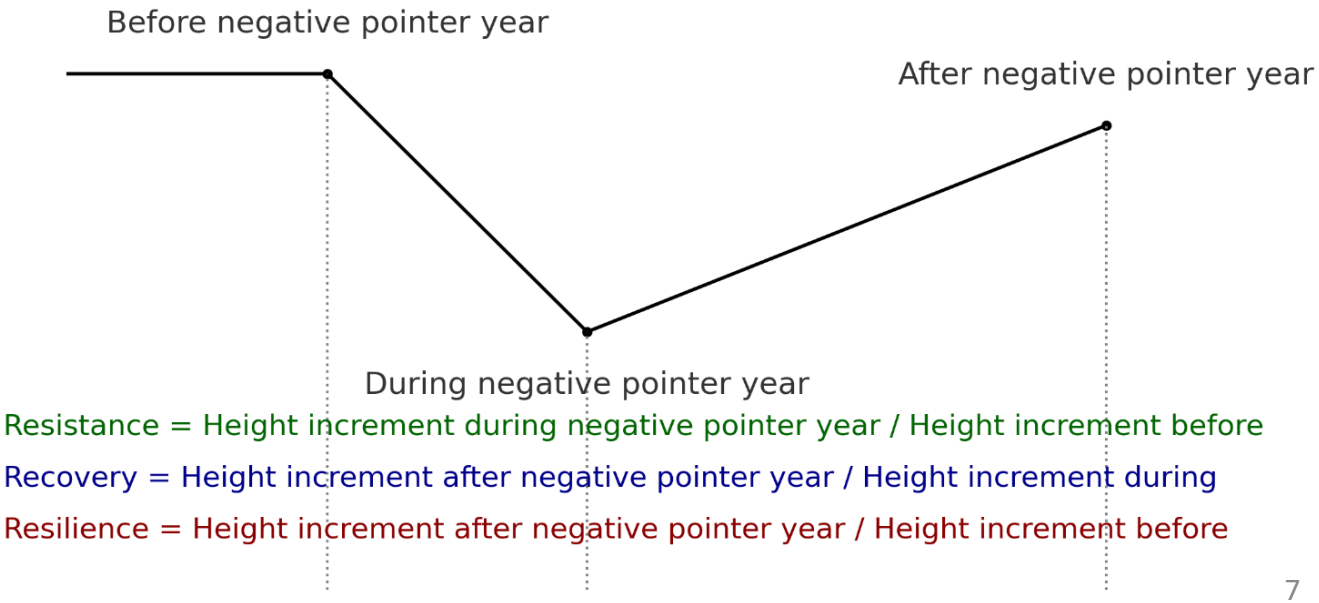


Trial	Area (ha)	Forest_type	Soil fertility
Ignalina	1,5	Cladinosa	Very oligotrophic
Laterzeris	2,0	Vacciniosa	(Very) oligotrophic
Veisieju	2,5	Vaccinio-myrtillosa	Oligotrophic
Nemencine	1,5	Oxalidosa	Mesotrophic
Silute	1,5	Hepatico-oxalidosa	Eutrophic

Radial increment analysis

- **~ 3500 radial increment cores (year 2025)**
- **Sensitivity Analysis**
  - Time series detrended; residual chronologies calculated.
  - Pearson correlations used to identify weather-growth relations.
  - Meteorological data (CRU TS4), covering temperatures, precipitation, Climatic Water Balance (CWB), Standardised Precipitation-Evapotranspiration Index (SPEI).
- **Resilience Assessment**
  - Resistance, recovery, resilience, and relative resilience indices calculated.



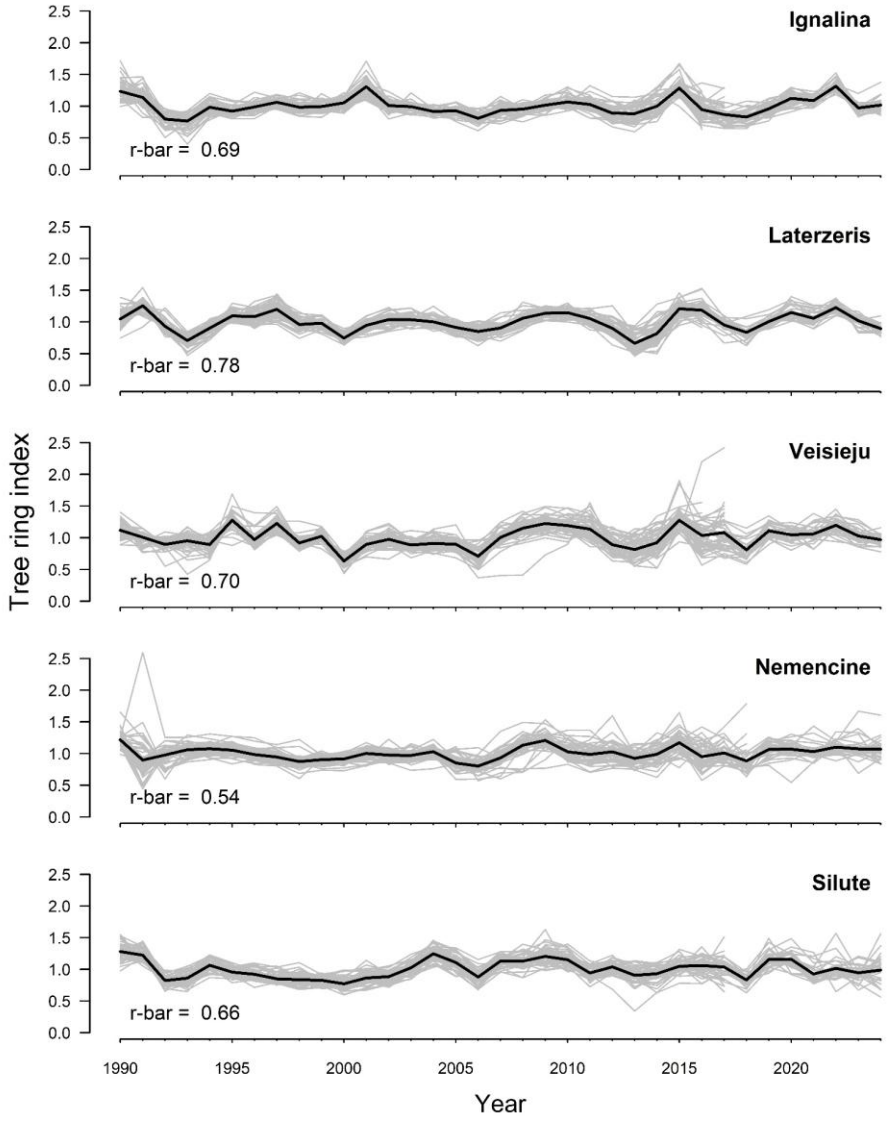


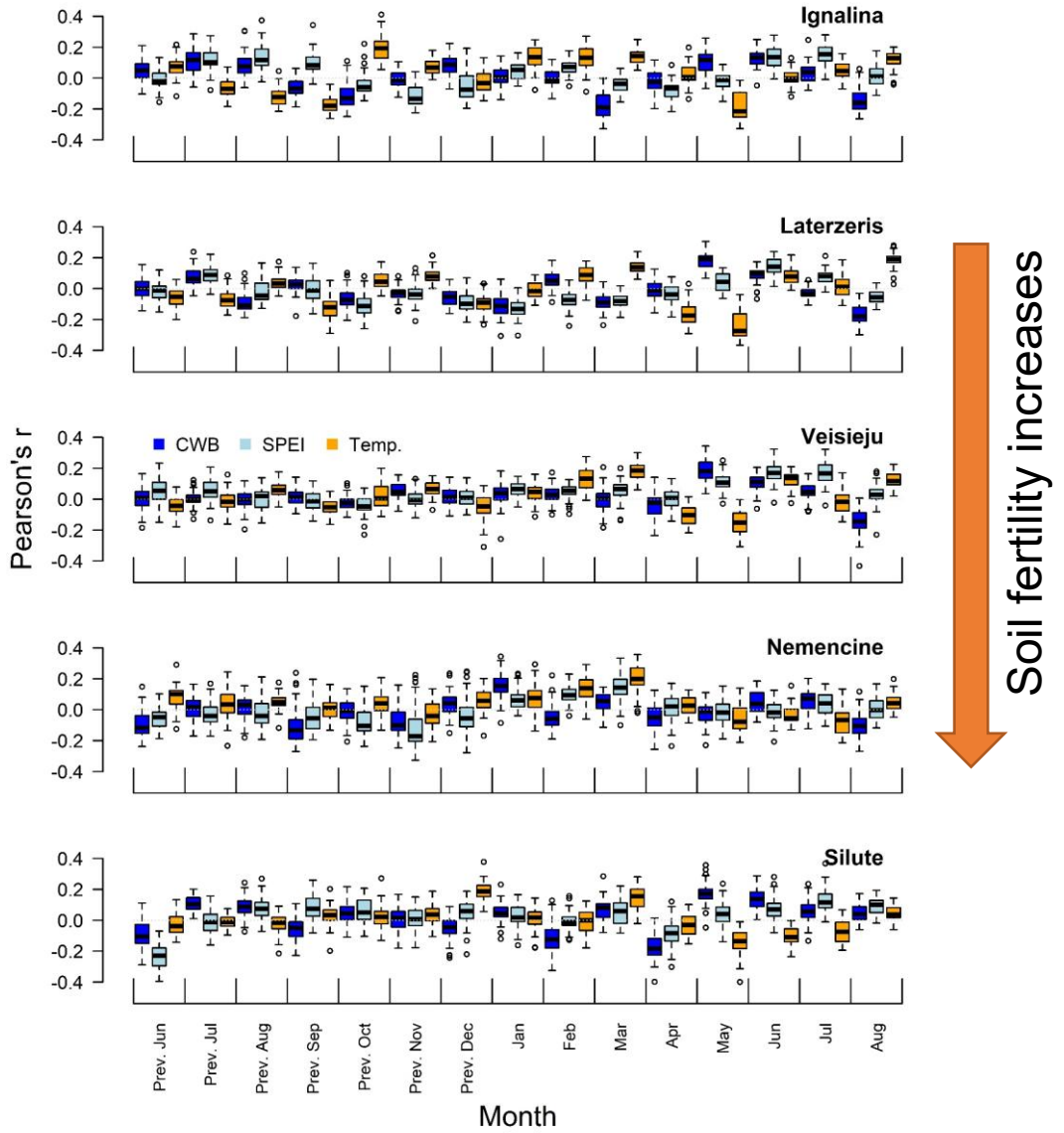
Resistance = Height increment during negative pointer year / Height increment before

Recovery = Height increment after negative pointer year / Height increment during

Resilience = Height increment after negative pointer year / Height increment before

Results: weather growth relations

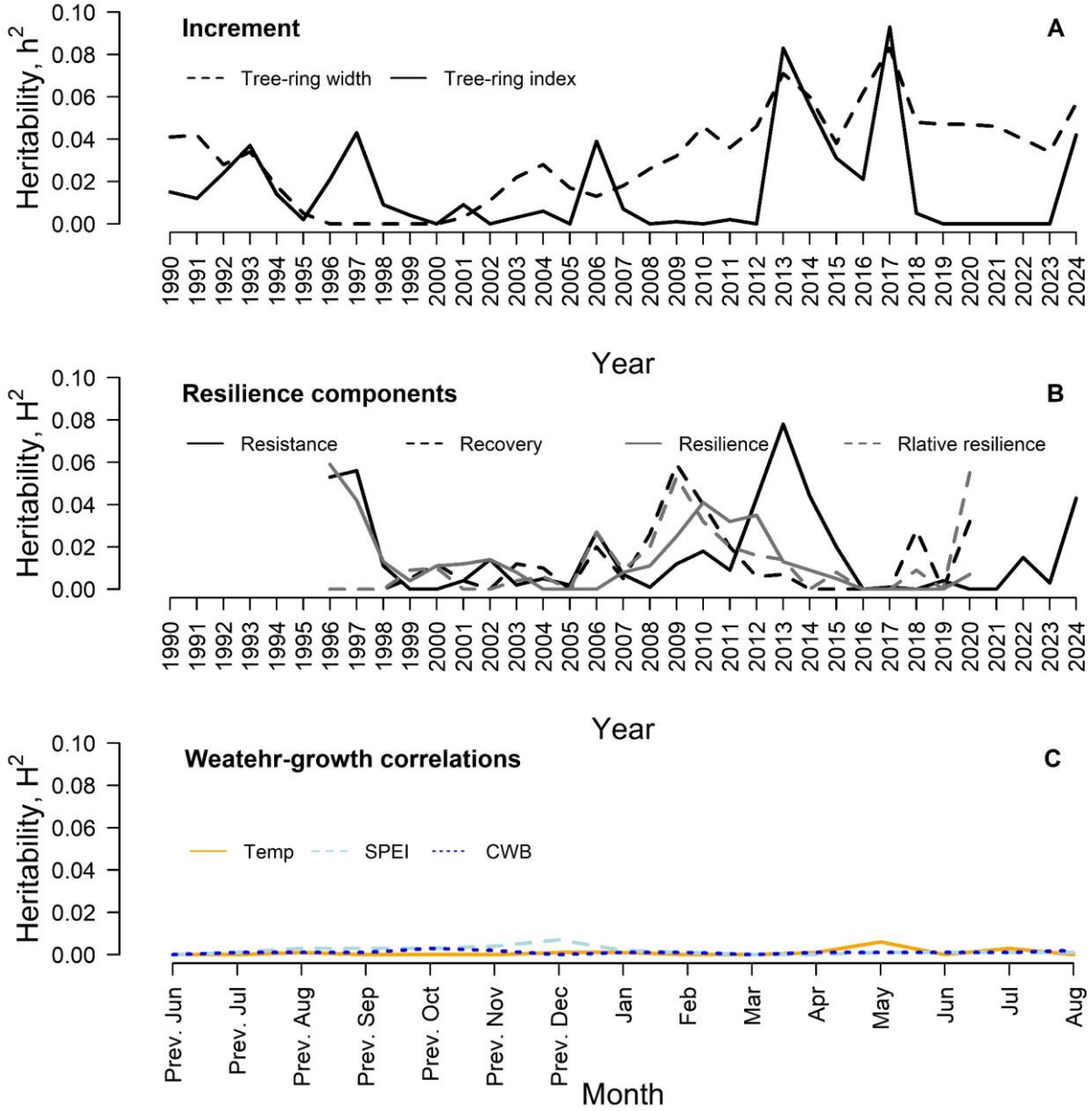




Results: multi-site analysis

Height: $h^2 = 0.02 \pm 0.017$

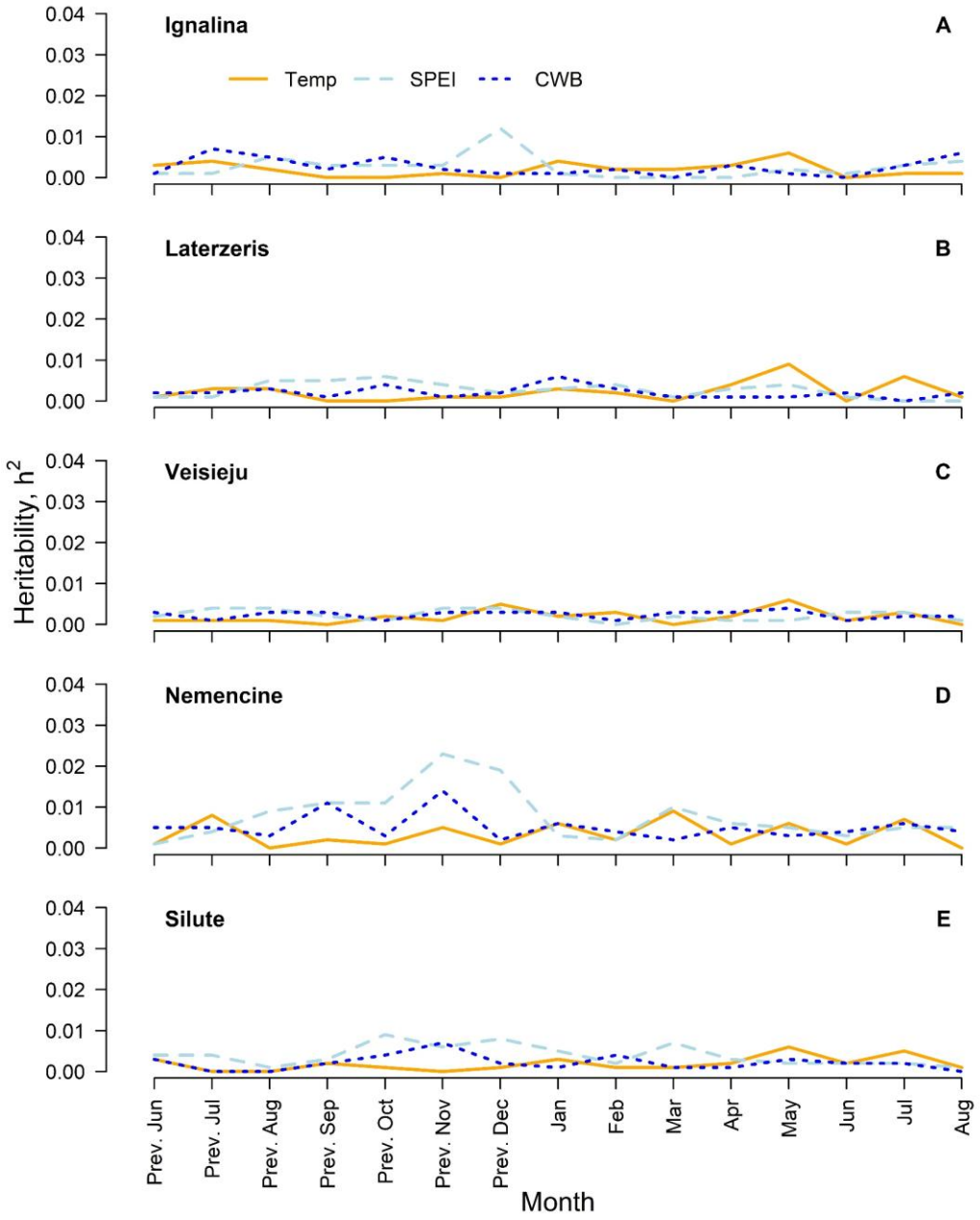
DBH: $h^2 = 0.03 \pm 0.014$



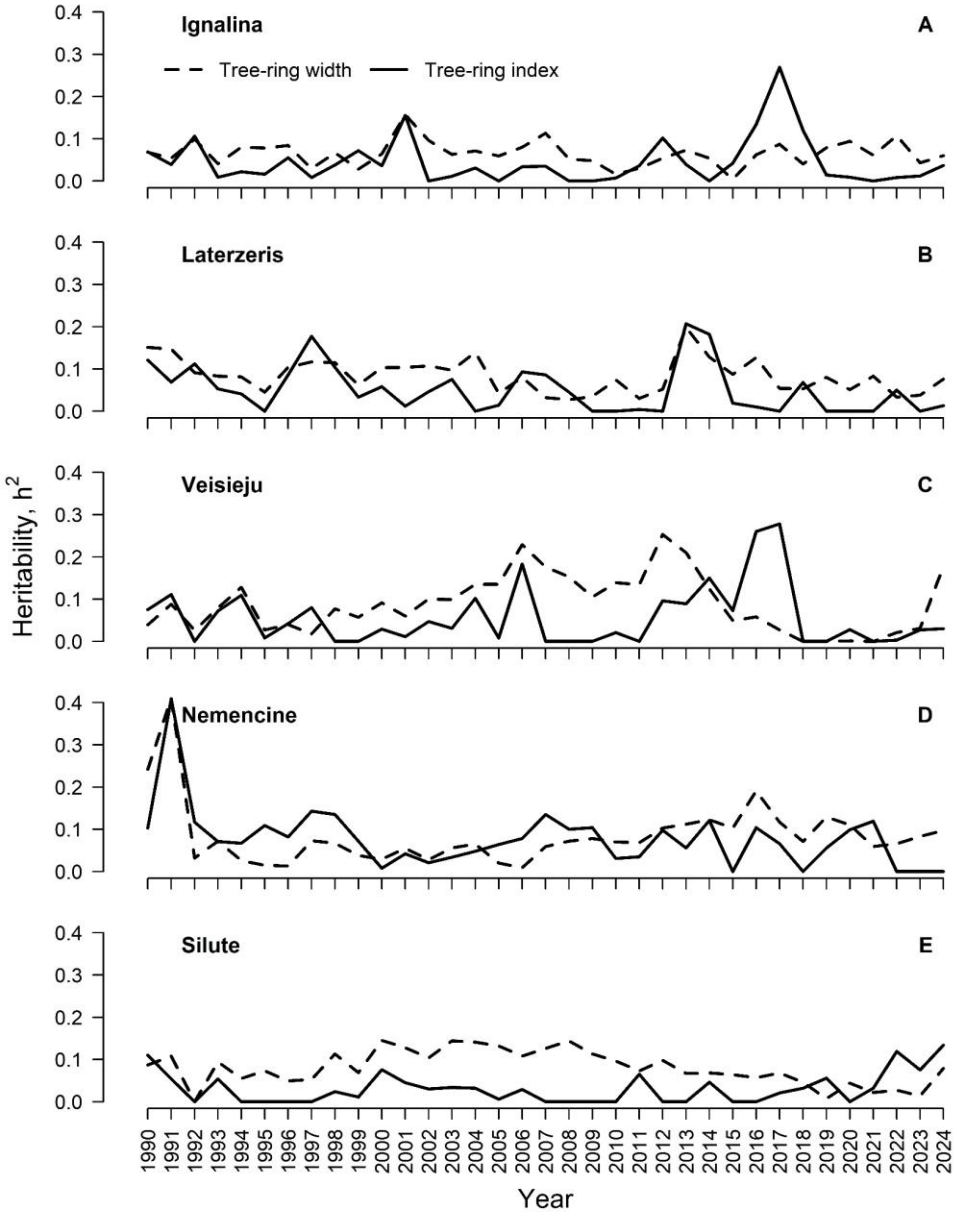
Results: separate sites

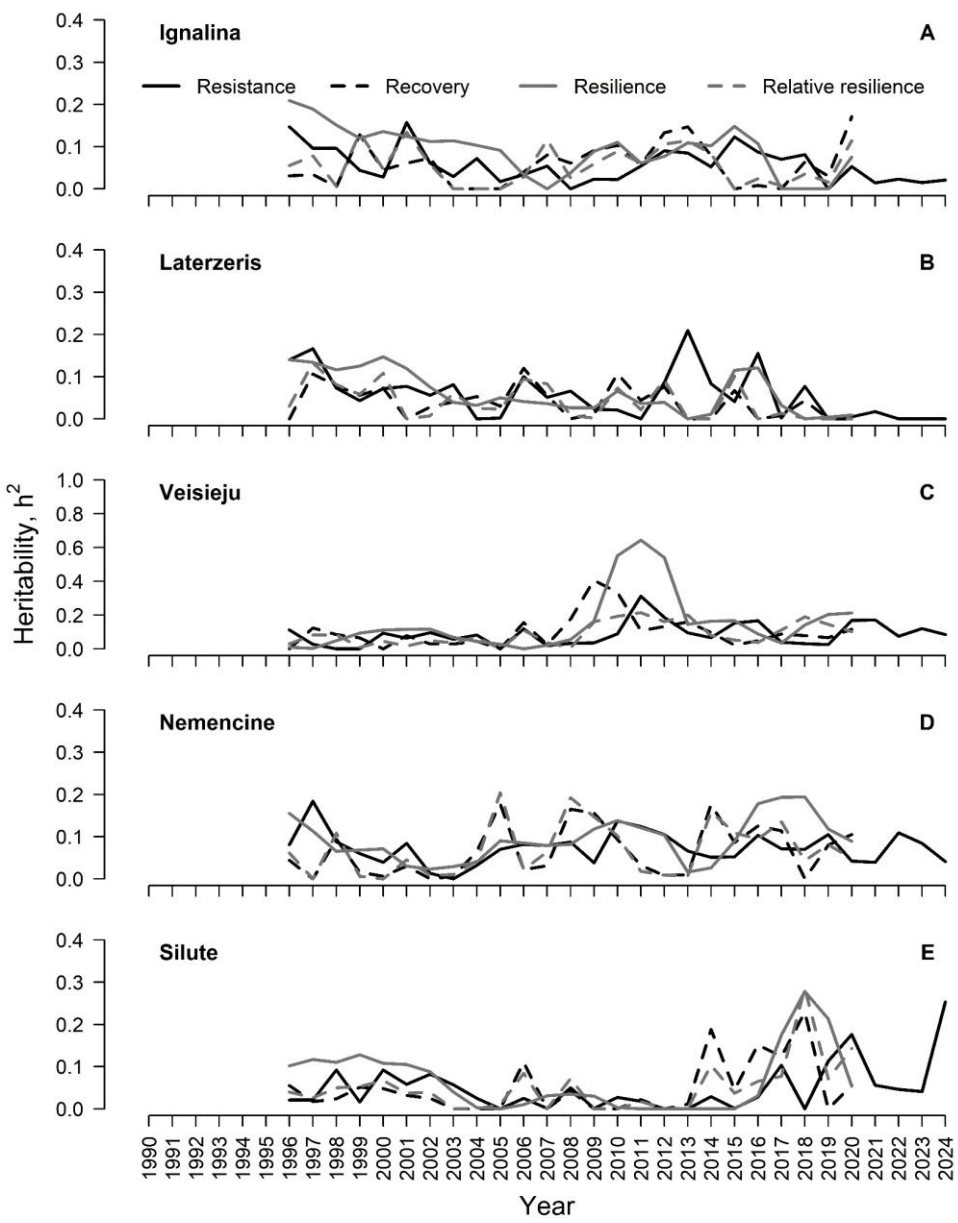
Trial	heritability h^2 ± SE	
	Height	DBH
Ignalina	0.26 ± 0.084	0.13 ± 0.048
Laterzeris	0.124 ± 0.066	0.04 ± 0.031
Veisieju	0.08 ± 0.054	0.07 ± 0.036
Nemencine	0.07 ± 0.050	0.05 ± 0.035
Silute	0.20 ± 0.08	0.08 ± 0.042

Soil fertility increases



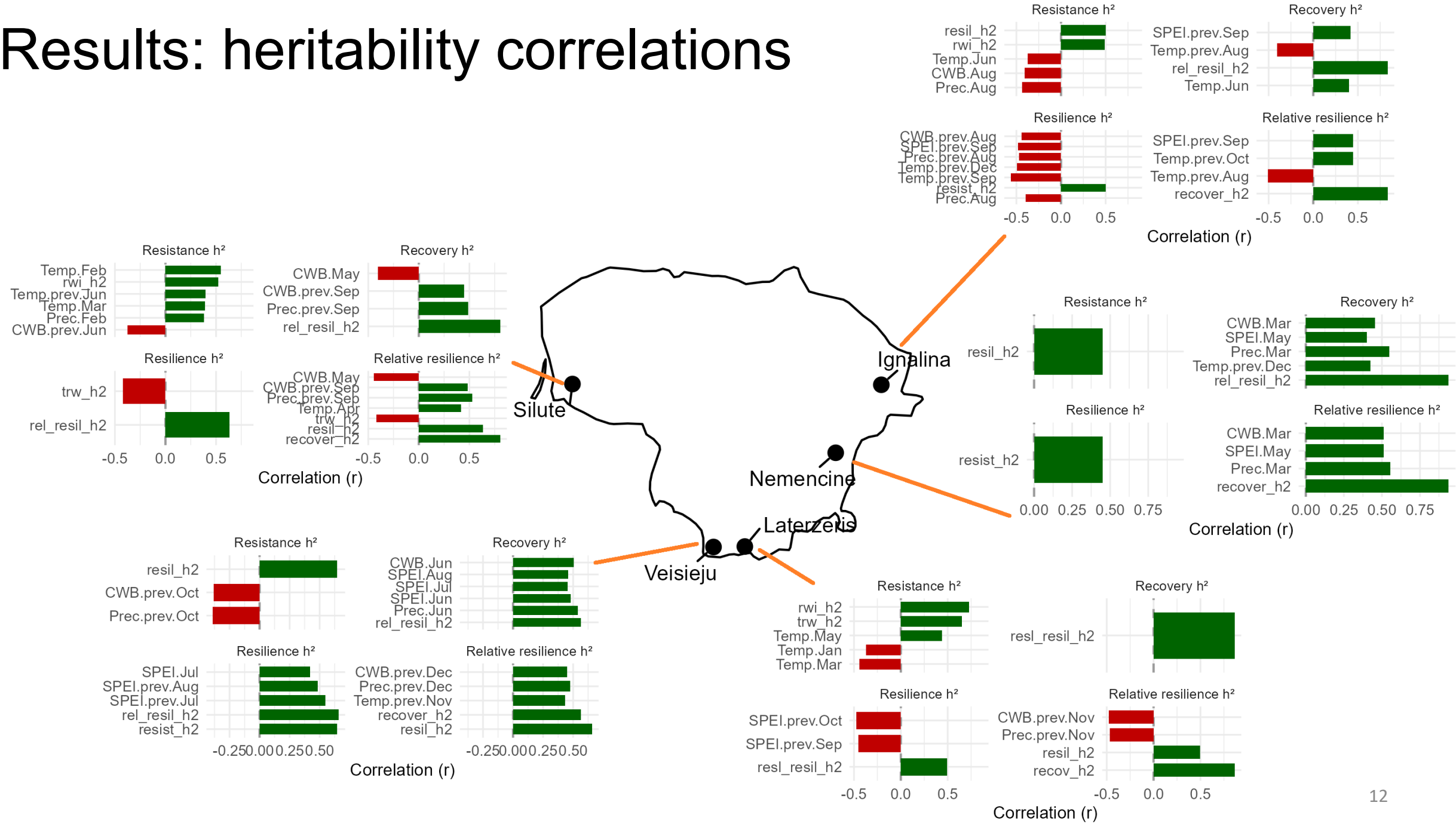
Results: separate sites (2)





Soil fertility increases

Results: heritability correlations



Concluding remarks

- No obvious trend over edaphic gradient for genetic variance in studied traits, yet differences among the trials were distinct.
- Heritability of weather-growth relationship was low overall, but site-specific signals emerged for resilience components in individual years.
- Genetic variance of resilience components showed weather sensitivity, especially to water balance (CWB, SPEI), indicating family-specific reaction → potential for selecting resilient genotypes for uncertain future conditions.
- Overall, tendency for positive relationship between CWB&SPEI and heritability of resilience components suggest more distinct genetic differences in more favorable moisture conditions.
    - Especially, genetic variation in how fast tree growth return after disturbance (drought)

Thank you!

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