

# Genetic control over growth sensitivity of Scots pine across edaphic gradient in hemiboreal conditions

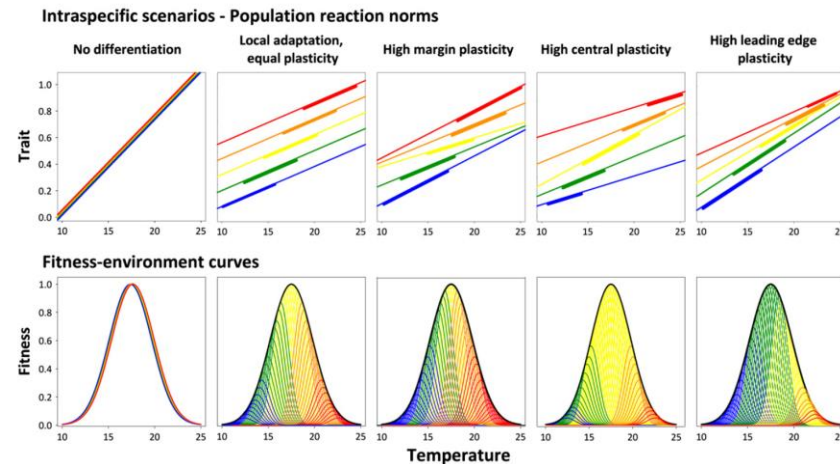
**Robert Matisons**

Pauls Zelčiņš, Diāna Jansone,  
Āris Jansons, Arnis Gailis

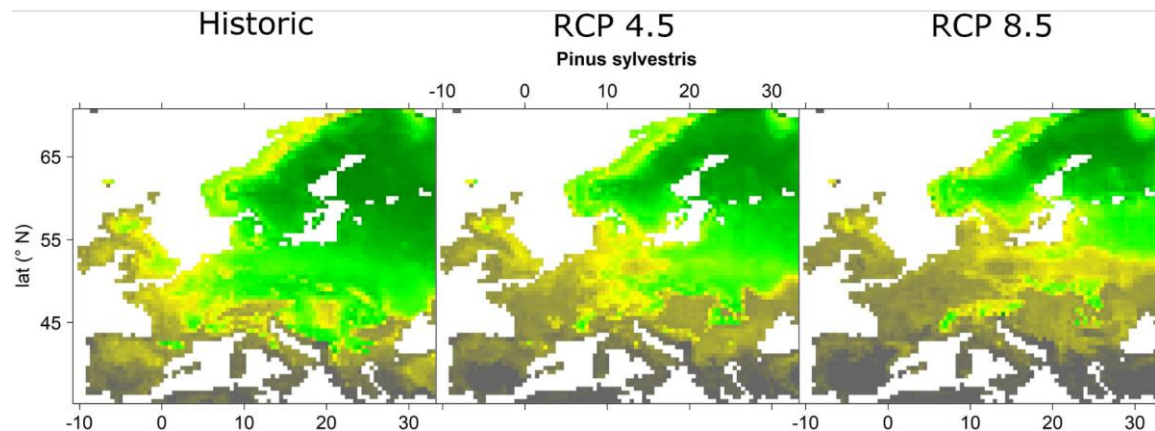
LSFRI 'Silava'

# Background

- Climatic changes and abundance of Scots pine
- Proactive adaptation and tree breeding
- Morphometric vs. functional climate-related traits
- Analysis of increment and its sensitivity
- Edaphic conditions and resilience



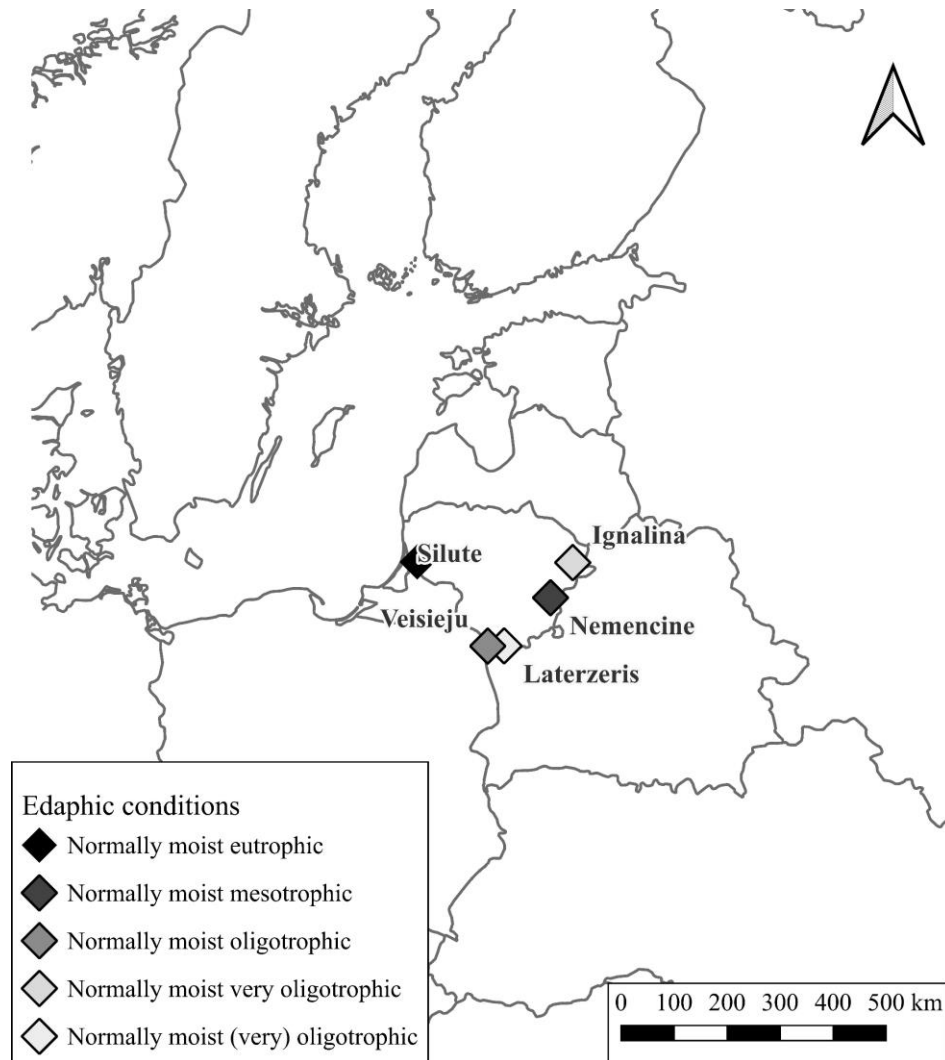
Valladares et al., 2014



Buras and Menzel, 2019

# Trials and crosses

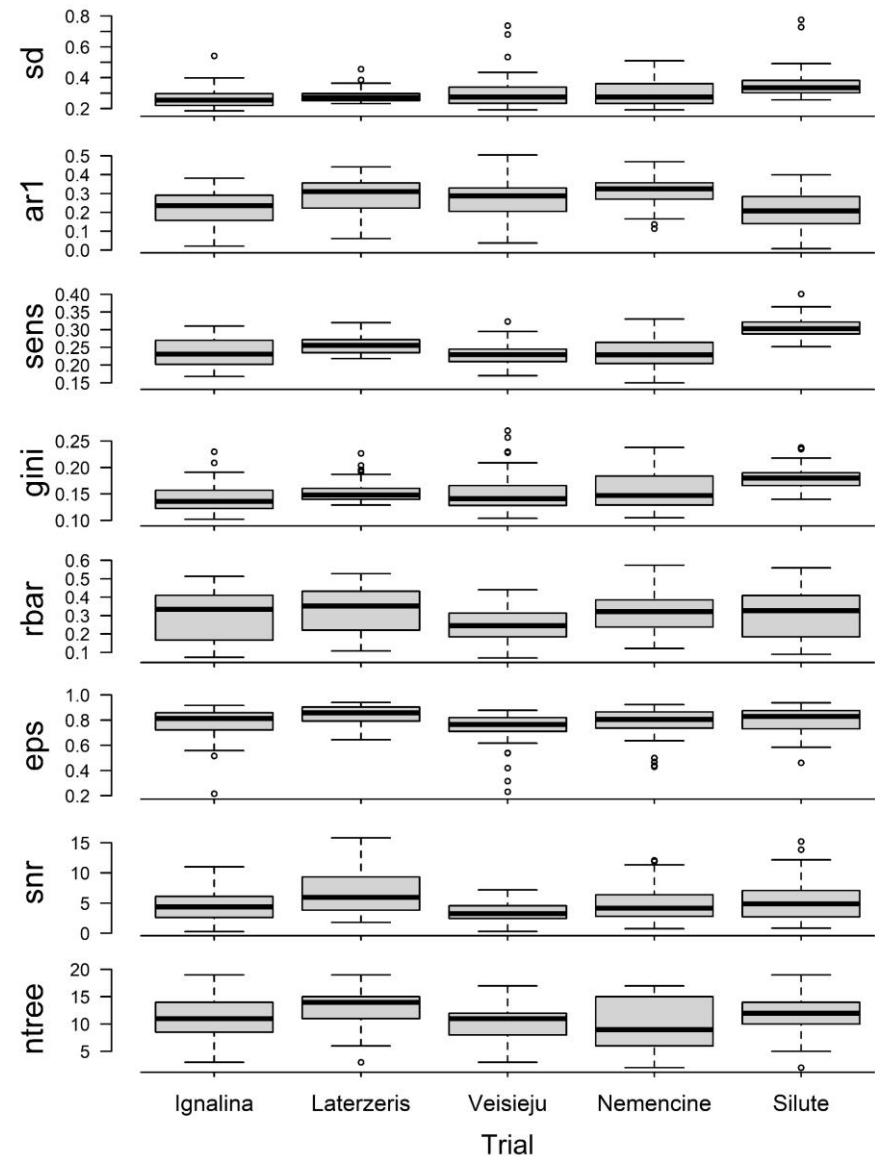
- Five trials: edaphic and climatic gradient (1983)
- Crosses within local populations across gradient
- 53 families (open-pollinated progenies of a mother tree)
- 3-4 replications (blocks) for each family within a trial
- 4-20 trees per trial per family cored
- one or two increment cores
- sampled in 2016 and 2025
- TRW measured and crossdated
- CRU TS data



# Statistical analysis

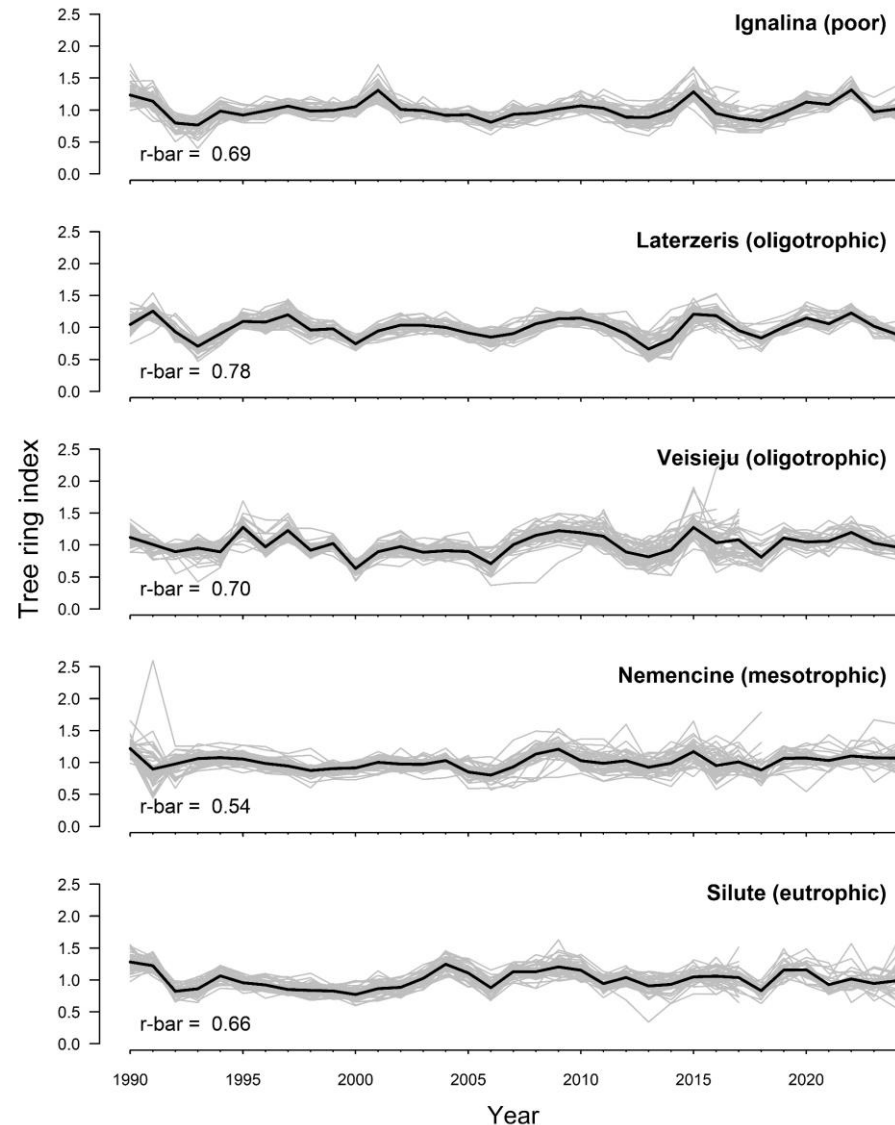
- TRW measured and crossdated
- Common interval: 1990-2024
- 25-year cubic spline detrending
- TRW metrics
- Single tree correlation analysis
- RRR analysis
- Variance partitioning: mixed model
- Within and across trials
- Heritability estimates

$$H^2 = \frac{\sigma_p^2}{\sigma_p^2 + \sigma_{p:t}^2 + \sigma_{p:b}^2 + \sigma_\varepsilon^2}$$



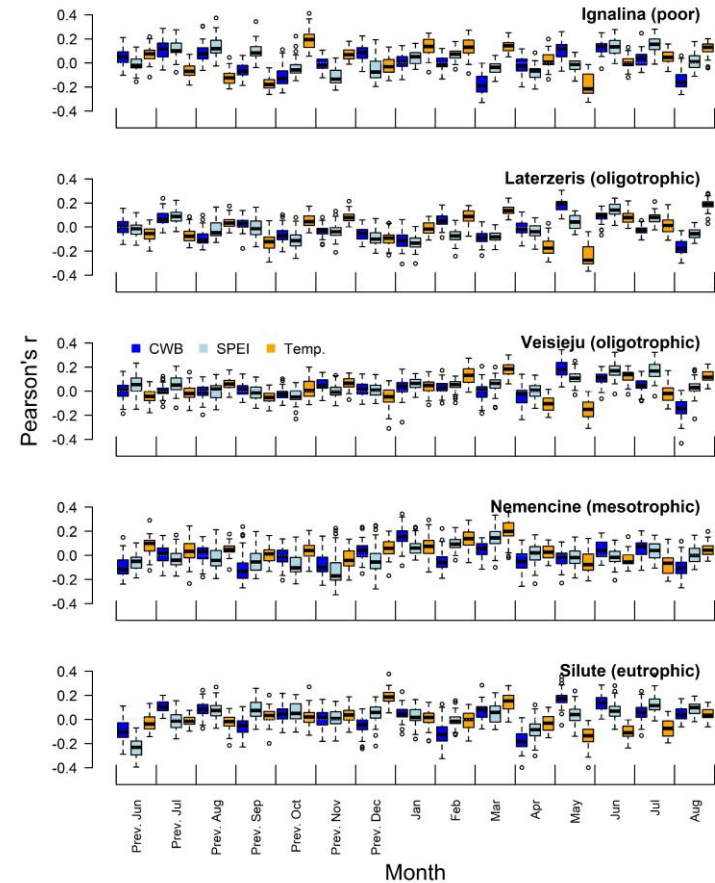
# Results: chronologies

- Optimal growing conditions and short series
- Higher annual variation under oligotrophic conditions
- Site specific variation
- Climatic and edaphic gradients



# Results: climatic correlations

- Temperature, precipitation and moisture balance, family means shown
- Temporary complex effects
- Summer drought signal
- Growing season length
- Locally specific effects of the climatic conditions
- Carryover effects under poor soils





# Results: heritability across trials

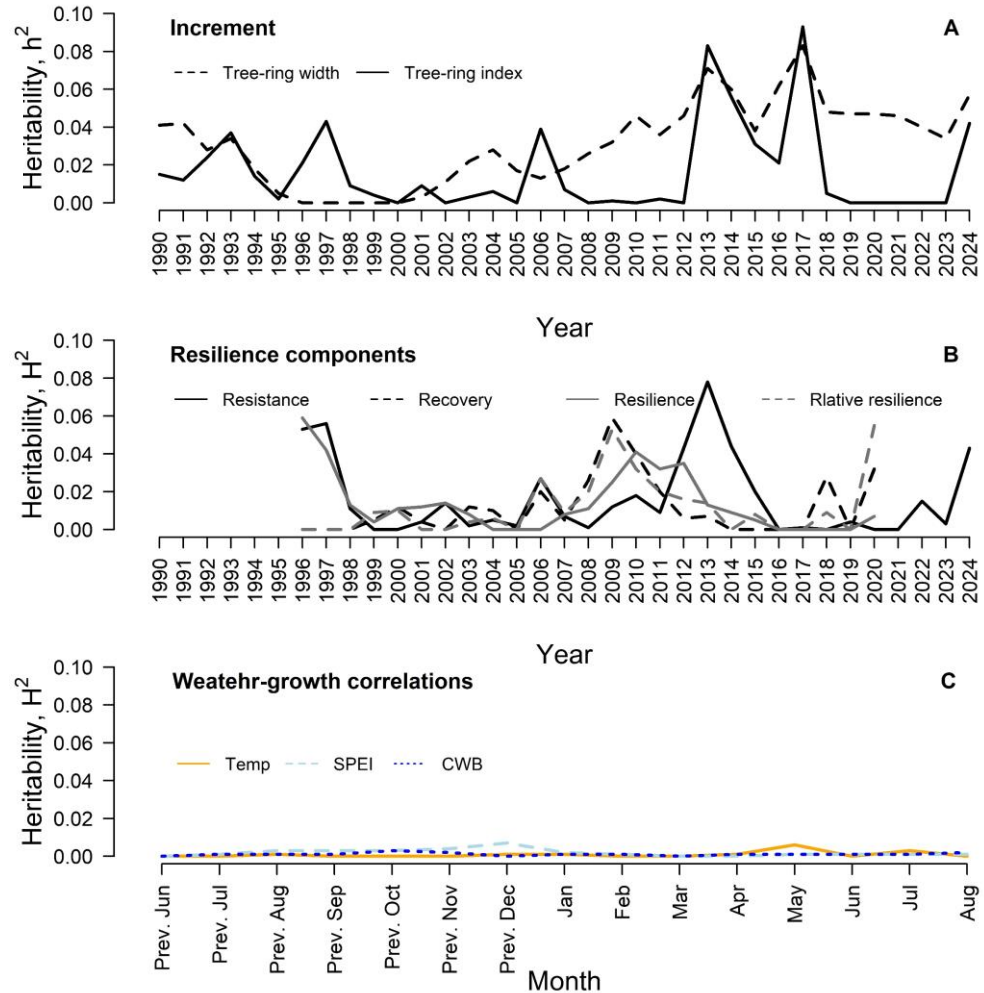
## ➤ Climatic correlations

```
mod=lmer(val~trial+row+scale(klim_mean)+
  +(1|family)+(1|trial:family),
  weight=Ntrw,
```

## ➤ increment and RRR components

```
mod=lmer(val~trial+row+
  +(1|family)+(1|trial:family),
```

## ➤ Low heritability (below practical)



# Results: $h^2$ correlation by trials

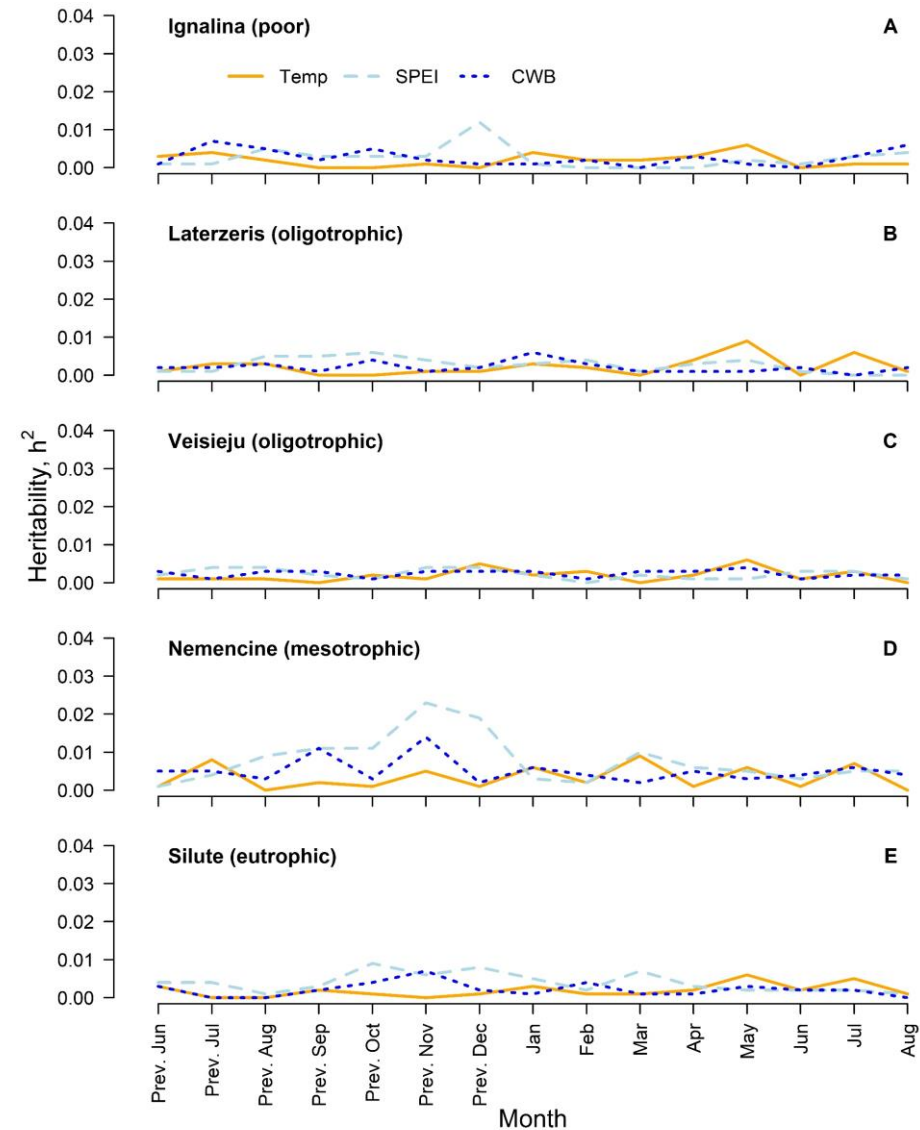
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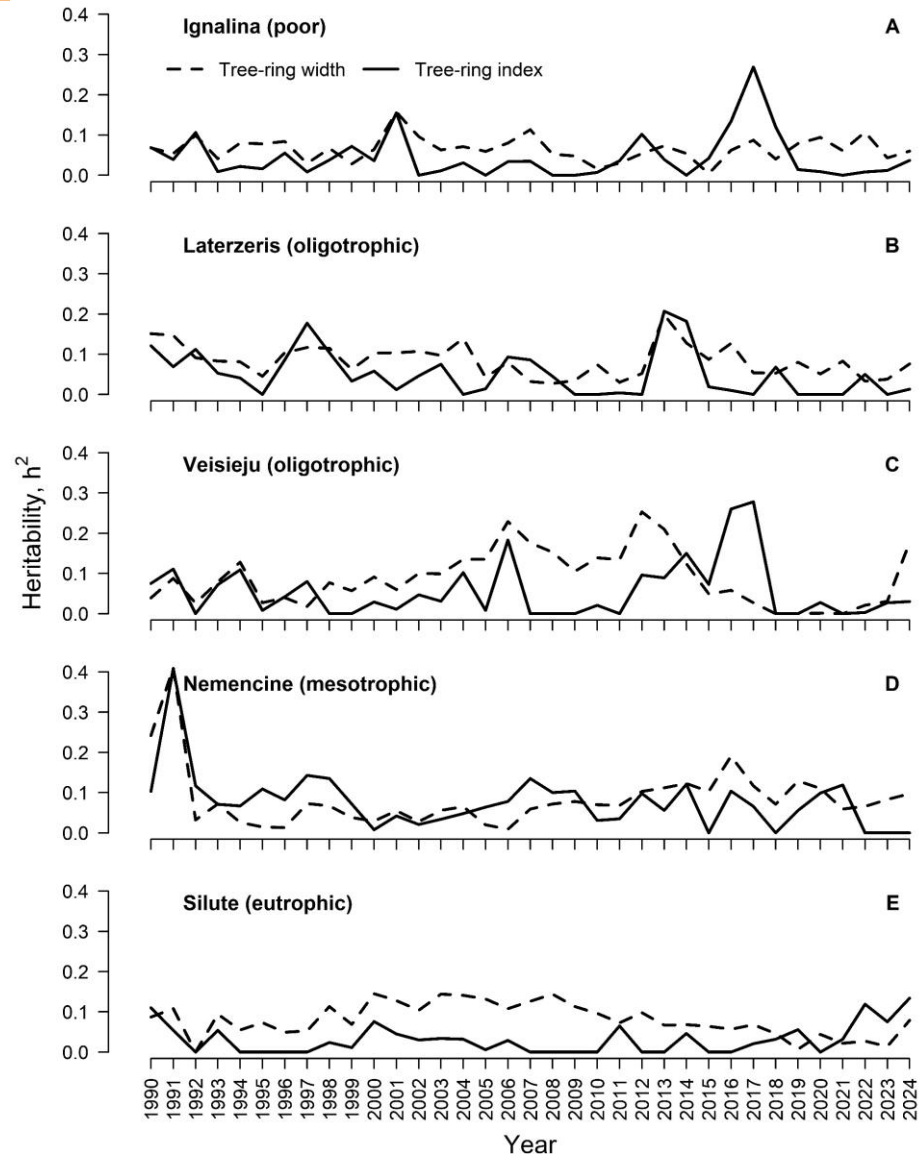
## ➤ Low heritability for correlation





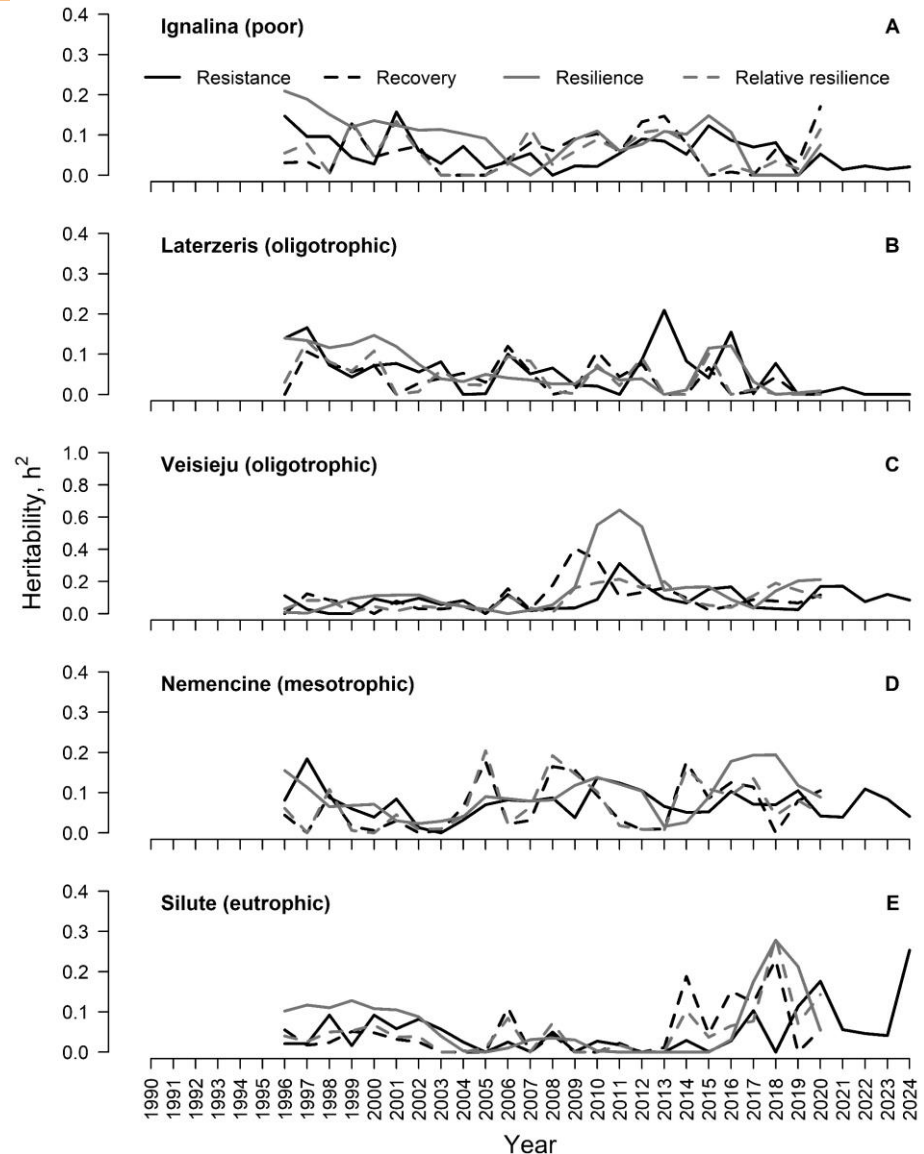
# Results: $h^2$ increment by trials

- Moderately high heritability for correlation
- Interannual variation



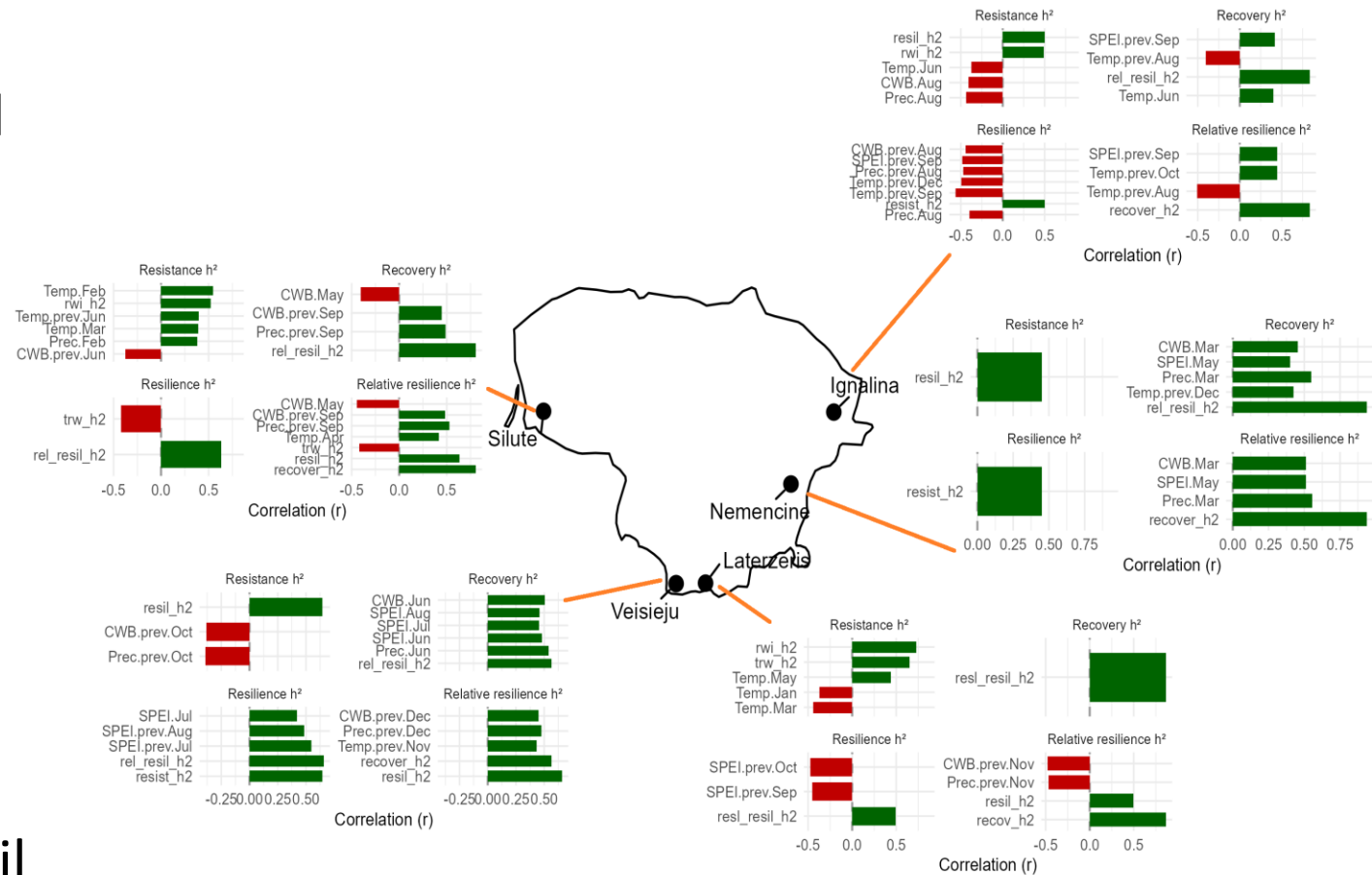
# Results: $h^2$ RRR comps by trials

- Similar to increment
- Moderately high heritability for correlation
- Interannual variation



# Results: heritability and climate

- Correlation between climatic variables and heritability time series
- Explicit climatic drivers
- Local differences
- Drought related drivers prevail



# Take home message



## Genetic controls

Correlations	No
Increment	Periodically
RRR indices	Periodically
Climatically controlled	Yes/extremes

## Q&A



Projekts Nr. VPP-ZM-VRIILA-2024/2-0002 “Inovācijas meža apsaimniekošanā un koksnes apstrādes pievienotās vērtības ķēdē Latvijas izaugsmei: jauni pakalpojumi, produkti, tehnoloģijas Forest4LV”