METEOROLOGICAL SENSITIVITY OF TREE-RING WIDTH OF SCOTS PINE AND NORWAY SPRUCE IN DRAINED STAND

Kārlis Bičkovskis[1, 2], Āris Jansons[1], Diāna Jansone[1, 2], Roberts Matisons[1]

[1]Latvian State Forest Research Institute "Silava", Latvia;
[2]Latvia University of Life Sciences and Technologies, Latvia

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Introduction

- Climate change →warmer and drier conditions.
- More frequent extreme weather events→ challange for sustainable forestry.
- Milder winters and earlier springs→Favourable in Northern regions.
- Adaptive management is essential for sustainable forestry. Climate-growth relationships →for predictions of species suitability.
- Scots pine (*Pinus sylvestris*) - drought sensitive
- Norway spruce (*Picea abies*) - susceptible to water availability.
- Lacking information of climate-growth relationships in drained sites.
- Aim:asses Norway spruce and Scots pine tree ring width weather sensitivity growing in drained peat soils.

Materials & Methods

- Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) (~100 years old).
- Deep peat soil (>80 cm), drained ~1960ies.
- 44 samples were collected and tree-ring width (TRW) measured.

- Climate variables:

1. Mean monthly temperature
2. Precipitation sum
3. Standardized precipitation-evapotranspiration index (SPEI) - a proxy for water availability.

- Standardized tree-ring chronologies were correlated with climate variables over the full period (1917-2022) and two subperiods (1917-1970 and 1970-2022).
- Climate-grwoth relationships were analysed a time window extending from June of the previous year (previous June) to October of the current growth year,

Table 1

Stand characteristics across inventory years (1951-2022) with respective stand species structure and mean values of stand DBH, height, basal area and standing stock

Year	Stand structure	DBH, cm	H, m	Basal area, m^2 ha^{-1}	Standing stock, m^3 ha^{-1}
1951	$6P_{50}$ $4E_{30}$	19	21.5	28	287
1957	$6P_{55}$ $5E_{55}$	20.5	22.5	30	342
1966	$6E_{45}$ $4P_{65}$	23.5	25	33	398
1980	$6E_{60}$ $4P_{80}$	26	27.5	38	500
1991	$6E_{70}$ $4P_{90}$	28	28.5	44	584
1995	$6E_{75}$ $4P_{95}$	30	30.5	46	624
2005	$6E_{85}$ $4P_{105}$	32	32	44	633
2011	$6E_{90}$ $4P_{115}$	33.6	33.3	42	631
2022	$6P_{125}$ $4E_{100}$	35.5	34.2	17	258

Results & Discussion

- Pine and spruce showed differentiating growth patterns (Fig.1.)

- Frequency of weather induced climate signal reduces with aging of trees (Fig.2)

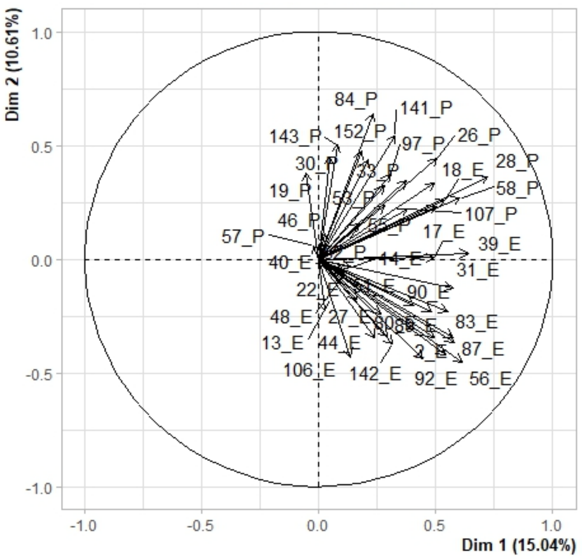

Fig. 1. **Principal component loadings of detrended TRW time series (P – Pine, E – Spruce)**

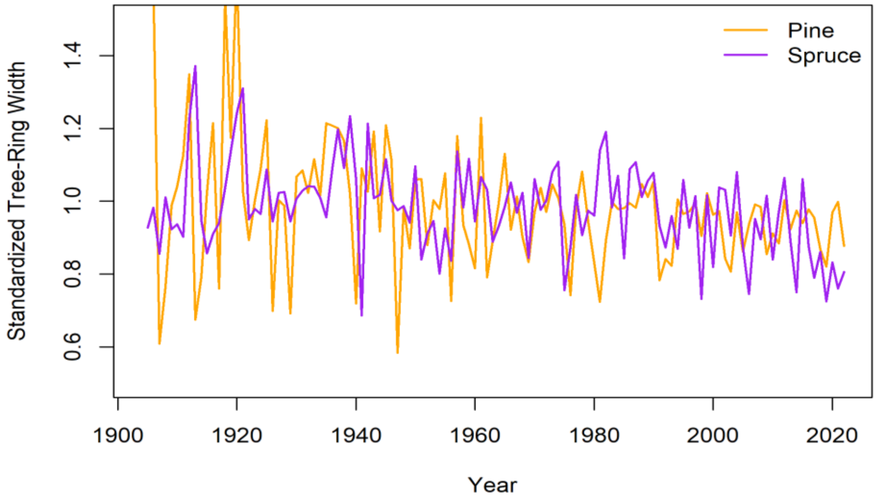

Fig. 2. **Standardized tree-ring width chronologies of trees growing in the drained stand**

Results & Discussion

- Non-stationary weather-growth responses.
- Positive correlation with late winter and early spring temperatures.
- Direct and carry over effects of water availability.
- Negative effect of humid autumn on tree increment for both species – particularly spruce.
- Pine exhibited a positive legacy effect of July precipitation during the early period.

Table 2

Scots pine and Norway spruce climate-growth correlations for periods 1917-1970 and 1970-2022

Parameter	**Spruce**			**Pine**		
	1917-1970	**1971-2022**	**1917-2022**	**1917-1970**	**1971-2022**	**1917-2022**
Temp.Feb	0.24	0.12	0.2	**0.49***	**0.29***	**0.34***
Temp.Mar	**0.28***	0	0.14	**0.49***	**0.33***	**0.39***
Temp.Apr	**0.35***	-0.11	0.13	**0.31***	0.16	**0.22***
Prec.prev.Jul	0.19	0.08	0.13	**0.32***	0.2	**0.24***
Prec.prev.Sep	**-0.38***	-0.01	-0.17	-0.1	0.05	-0.05
Prec.prev.Nov	**-0.26***	0.25	0.01	-0.25	0.05	-0.08
Prec.Jan	0.2	-0.03	0.08	**0.27***	-0.1	0.05
Prec.Feb	-0.09	0.01	-0.02	0.21	**0.27***	**0.22***
Prec.Aug	-0.14	**-0.31***	**-0.25***	-0.1	0.01	-0.02
SPEI.prev.Oct	**-0.39***	0.07	-0.13	-0.15	-0.07	-0.11
SPEI.prev.Nov	**-0.51***	0.05	-0.19	**-0.25***	-0.08	-0.15
SPEI.prev.Dec	**-0.32***	0.14	-0.06	-0.18	-0.15	-0.16
SPEI.Jan	-0.09	**0.27***	0.1	-0.01	-0.13	-0.09
SPEI.Feb	0.05	0.1	0.1	**0.27***	-0.04	0.04
SPEI.Mar	0.24	-0.09	0.06	**0.41***	0.03	0.16

Conclusions

- Weather sensitivity responses of conifer species growing in drained peat soils were complex, predominantly associated with temperature and precipitation patterns.
- Positive effect of milder winter and early spring onset for Scots pine suggests species suitability in drained stands in future climate.
- No negative correlations were observed with temperature that would suggest drought stress of spruce during summer months.
- Spruce showed negative growth responses in the later development stage, reflecting its preference for well-aerated soils and highlighting the importance of maintaining functional ditch networks in drained spruce stands.

Thank you for attention!

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