Tree rings as climate archives: Growth response of *Pinus sylvestris* in the Lower Silesian Forests

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The Lower Silesian Forests constitute one of the largest contiguous forest complexes in Poland, serving important ecological and economic functions. The stands in this region are dominated by Scots pine (*Pinus sylvestris* L.), which is an important forest-forming species and a sensitive bioindicator of environmental changes. Analysis of the annual growth of this species allows for the assessment of stand responses to climatic variability (Wilczyński 2020). The aim of this study was to determine the relationship between the average monthly air temperature and monthly precipitation and the width of annual growth rings of Scots pine in the Lower Silesian Forests.

The study material consisted of 128 increment samples collected from trees growing in six forest plots representing four forest habitat types in the Wymiarki Forest District. Samples were collected in June 2025 using a Pressler borer in accordance with standard dendrochronological methodology. The material was prepared, scanned, and measured with an accuracy of 0.01 mm using the CooRecorder software, and then processed using the CDendro software. The accuracy of the dating was verified in COFECHA, while the growth ring series were standardized in ARSTAN, resulting in six site chronologies. The analysis included tree-ring width (TRW) and its components earlywood (EW) and latewood (LW).

The length of the ring-width series ranged from approximately 120 to 150 years. The total number of dated and measured annual TRW in each chronology ranged from about 1800 to nearly 3000, with an average exceeding 2300 rings. Similar measurements were also performed for EW and LW.

The relationships between annual growth, EW, and LW and climatic factors were analyzed using statistical methods in the RStudio environment for the period 1952–2024, considering the period from October of the previous year to September of the current year. The interpretation of the relationships between growth increments and climatic conditions was based on the classification of thermal conditions according to Kalbarczyk and Kalbarczyk (2012) and precipitation conditions according to Kaczorowska (1962).

The results indicate that the width of annual growth rings in Scots pine is most strongly associated with thermal conditions in late winter and early spring, as well as with precipitation during the spring and summer. Higher temperatures in February and March promoted increased growth. At the same time, a deficit of precipitation during the summer led to reduced growth, particularly in the LW.

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