Pinus sylvestris L. drought stress reaction thresholds are captured by both intra- and inter-annual variation in xylem morphology

S. Mikhailov[1,2,3], M. Fajstavr[1,2], P. Horáček[1,2]

[1]Department of Xylogenesis and Biomass Allocation, Global Change Research Institute of the Czech Academy of Sciences, Bělidla 986/4a, 60300 Brno, Czech Republic; [2]Department of Wood Science and Technology, Faculty of Forestry and Wood Technology, Mendel University in Brno, Zemědělská 3, 61300 Brno, Czech Republic; [3]Laboratory of Ecology of Plant Communities, Komarov Botanical Institute of the Russian Academy of Sciences, Professora Popova str. 2, 197376 Saint Petersburg, Russian Federation

Corresponding author: mikhailov.s@czechglobe.cz

Keywords: *Pinus sylvestris* L., xylogenesis, xylem morphology, tree-ring width, drought

Key message: Do both individual tracheids and total tree-ring widths provide the same information on how far Scots pine can withstand drought?

As drought-tolerant tree species, *Pinus sylvestris* L. (Scots pine) in Central Europe yet expresses drought-induced secondary growth variability, reflected in cellular and tissue level changes in xylem anatomy. Here, we investigate to what extent Scots pine trees can withstand water deficit stress, and what level of observation better allows to identify it. To study Scots pine xylem formation, 3 research plots (150-350 m asl), representing managed Scots pine stands aged 40-100 years, were selected in the south of the Czech Republic. At each plot, weekly microcore sampling was performed on 6 dominant trees during the growing seasons 2020 and 2021, whereas macrocores were taken from another 12 dominant trees at the end of the study. To relate xylem morphology to climatic variables intra- and inter-annually, we analyzed: i) current timing of tracheid development; ii) morphological metrics of fully formed annual rings, such as tracheid radial diameter, secondary cell wall thickness, and number of tracheids; iii) tree-ring width time series for the whole tree lifespan. Our work aims to identify the numerical thresholds in number, radial dimensions of tracheids and tree-ring widths, up to which these variables can decline without tree dieback. We hypothesize that the same mechanism of drought stress reaction in Scots pine is revealed regardless of tree age, though the information kept by cells and tissues might be different.