1. PHD PROJECT DESCRIPTION (4000 characters max., including the aims and work plan)

Project title: Plasticity of Wood Anatomical Structure in Response to Climate Change in Selected Tree Species of the Dinaric Mountains

1.1. Project goals

Trees, as long-lived organisms, respond to climate change and "archive" its effects within their wood structure. In the temperate climate zone, tree rings can be dated with annual precision, and cellular structures can be analyzed to study seasonal responses. Modern research techniques allow for the analysis of up to 65 wood anatomical traits, which can be classified according to their functional roles: (i) traits related to radial growth, (ii) traits reflecting changes in cell size, (iii) traits responsible for water conduction, and (iv) traits with mechanical functions (Piermattei et al., 2020). The aim of the project is to conduct a detailed analysis of these traits and to assess the influence of temperature, precipitation, and the Standardized Precipitation Index (SPI) on tree growth dynamics and wood cell structure.

1.2. Outline

Climate trend analyses indicate an increase in total precipitation across the Western Balkans region, particularly during the winter season. These changes have intensified extreme weather events, including droughts during the growing season and increased flood risk (Belis C. A. et al., 2022). The consequences of climate change in this region also include more frequent and prolonged heatwaves and droughts, forest degradation linked to wildfires, defoliation, and tree mortality, as well as earlier onset of the growing season and increased risk of late spring frosts (Vuković & Mandić, 2018). In light of current and projected climate change, research on tree growth dynamics is gaining particular importance, especially considering the economic significance of forests in the region. Literature indicates that nearly 60% of forest disturbances are directly caused by climate change (Seidl et al., 2017). As part of the project, in collaboration with climatologists, extreme climate events will be identified using data from the CRU (Harris et al., 2020) and EOBS (Klein Tank et al., 2002) databases covering the past hundred years. Based on these data, tree responses to droughts, their resistance to adverse weather conditions, and their recovery capacity will be analyzed according to the methodology proposed by Lloret et al. (2011).

1.3. Work plan

The work plan is scheduled for a duration of 48 months. In the initial stage of the PhD project, research will be conducted on samples that have already been collected. The material was obtained either by the second supervisor or in collaboration, and is currently stored at the Department of Ecology and Biogeography at Nicolaus Copernicus University. Subsequent stages will involve the analysis of the research material and are directly linked to the achievement of the project's objectives. During the first years of the doctoral program, the PhD candidate is also expected to participate in a specialized scientific school and selected national and international conferences. Further activities will focus on processing the research results and preparing three scientific publications, which will be included in the doctoral dissertation (Figure 1).
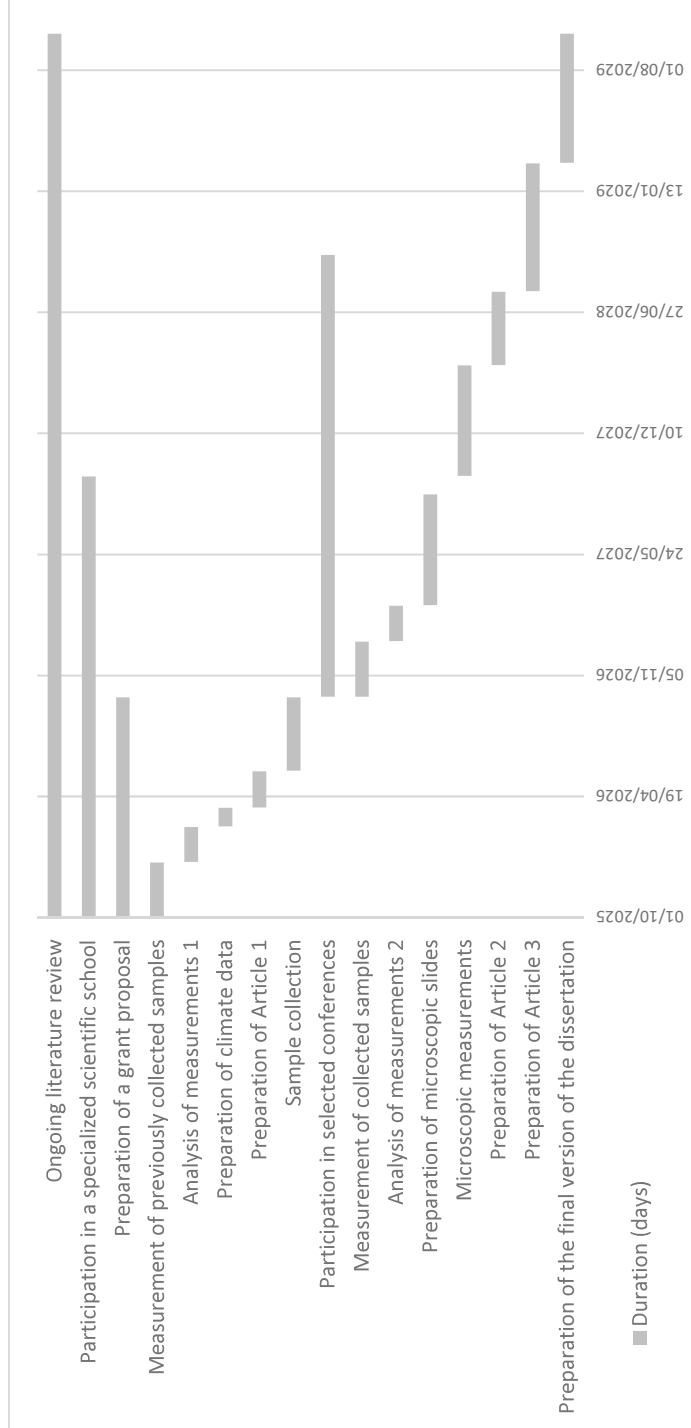

Figure 1. Tasks related to the implementation of the grant and their duration in days from October 1, 2025 to September 30, 2029.

1.4. **Literature** *(max. 7 listed, as a suggestion for a PhD candidate preliminary study)*

Lloret, F., Keeling, E.G. & Sala, A. (2011) Components of tree resilience: Effects of successive low-growth episodes in old ponderosa pine forests. Oikos, 120, 1909–1920.

Piermattei, A., Arx, G. von, Avanzi, C., Fonti, P., Gärtner, H., Piotti, A., et al. (2020) Functional Relationships of Wood Anatomical Traits in Norway Spruce. Frontiers in Plant Science, 11

Seidl, R., Thom, D., Kautz, M., Martin-Benito, D., Peltoniemi, M., Vacchiano, G., et al. (2017) Forest disturbances under climate change. Nature Climate Change, 7, 395–402.

Vuković, A. & Mandić, M.V. (2018) Study on climate change in the Western Balkans region.

1.5. **Required initial knowledge and skills of the PhD candidate**

Knowledge of the macroscopic and microscopic structure of wood, as well as dendrochronological methodology. Ability to develop a reference chronology and perform basic statistical analyses in R using specialized packages.

1.6. **Expected development of the PhD candidate's knowledge and skills**

It is expected that the PhD candidate will deepen their knowledge in the field of wood biology and ecophysiology, as well as develop skills in scientific writing and presenting research results at international conferences.