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PROJECT REPORT

CORK RING DETECTION AND MEASUREMENT – DEVELOPMENT OF NEW TECHNIQUES

AUGUSTA COSTA

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Scientific objectives

The main goal of this project was to test on cork samples, the detection and measurement of large cork-ring sequences using the newest techniques available for the detection of wood rings, across large tree-ring sequences, on core increments or on entire cross sections. In fact, these techniques have been extensively used in wood samples, allowing a precise measurement of annual wood ring widths, however, they have never been tested on cork samples in more detail.

Cork is the thick outer bark of cork oak trees (*Quercus suber* L.) which are located only in western part of Mediterranean Basin, a sensitive area for climate change effects. Cork is periodically harvested from the cork oaks stem and branches in a minimum of 9-years cycles (called the cork harvest period). In the cork, the annual rings have a specific patterned growth period, i.e., a clear successive cork rings banding, similar to those in wood. These annual cork rings preserve an archive that it is encoded not only by climatic conditions but also by disturbances (e.g. recurrent cork harvesting), by site-specific species growth pattern and by the tree (genetic) variability.

The data on cork ring widths will allow to built cork ring width chronologies, their standardization and, finally, modelling cork growth in trees under recurrent cork harvesting pressure, in Mediterranean-climate conditions.

The final scientific objectives are, at tree level, to use cork growth to: 1) assess the resilience of cork oak to cork harvesting and; 2) seek for climate sensitivity and tree variability in the responsiveness of cork oak to drought (e.g. evaluate the impact of episodes of in-between recurrent drought periods in the cork oak growth). This knowledge will allow a more comprehensive understanding on cork oak woodland ecosystems responses to varying environment in Mediterranean-region, which is characterized by tree variability and strongly threatened according to scenarios of climate change effects.

In this project, we propose to build extended cork ring width chronologies (for several decades, minimum of 30 years) by piecing cork ring annual widths found in thick cork samples. These time-series cork ring width chronologies can be built using the traditional image analysis techniques to identify annual banding and two new techniques: 1) the High-Frequency Densitometry and; 2) the Abrasive Hardness. These techniques have already been used in wood ring analysis but have never been used in cork rings in more detail. These new techniques will be done in collaboration with Freiburg University - Institute for Forest Growth, in Germany, under the coordination of Prof. Dr. Heinrich Spiecker.

Final conclusion

The mission described in this project are aimed at strengthening the existing link between CENSE - Center for Environmental and Sustainability Research, in the Universidade Nova de Lisboa (Portugal) and the University of Freiburg, Institute for Forest Growth (Germany).

The specific goal of this mission was to learn new techniques and to take measurements in raw material such as cork similar to what is being done in wood. Also, this mission allowed using instruments, techniques and methodologies for cork ring detection and measurement not available in the Portuguese institutions. Cork is produced in cork oak woodlands in Portugal (the biggest cork producer country, responsible for more than 50% of all cork produced annually worldwide, more than 150 thousand ton.).

The cork ring width extended series constitute basic knowledge on the underlying processes governing the ecological resilience of the cork oak woodlands and will contribute to the design of adaptation measures to be considered in a near future in southern European countries. The goal is to keep the value of these woodlands ecosystems and make them more productive, resilient and with improved adaptive capacity to climate change effects, key issues for marginal forests in Europe (MaP-FGR).

This mission will also allow the development of the first scientific project that the researcher Augusta Costa is developing as a Principal Investigator (PI). Finally, it is already planned to publish the results of the HF-densitometry analysis on cork in an international scientific journal, in the form of a research note.

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