PROJECT INFORMATION

Project title:	**Understanding the environmental drivers of Mediterranean oak decline at pan-European scale**
Project ID:	202
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PROJECT DESCRIPTION

Principal investigators

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Background

In recent years, events of extensive tree dieback and mortality related to both biotic and abiotic factors have been detected across the world affecting the health and vitality of different forest ecosystems (Allen et al. 2010, Carnicer et al. 2011). Long periods of drought conditions, together with rising temperatures, affect tree growth and defence mechanisms. These factors make forest ecosystems prone to insect and pathogen attacks that in some cases are the ultimate cause of tree death (Anderegg et al. 2013). In Europe, one of the most severe cases is the Oak decline which affects different species of Quercus across a wide range of ecosystems and bioclimatic regions (Thomas et al. 2002). Particularly in the Mediterranean region *Q. ilex* has been one of the most affected species but decline has been also reported for *Q. suber* on the Iberian Peninsula (de Sampaio e Paiva Camilo-Alves et al. 2013, Ibáñez et al. 2015). These species are the main structural and engineer component of a unique agro-silvo-pastoral system around the Mediterranean Basin, known as "Montado" in Portugal and as "Dehesas" in Spain, or "Kouri" in Greece, which consequently suffers the general oak decline problem. Dehesas are considered an EU habitat of interest based on its high biodiversity (Habitat Directive) largely derived from its characteristic multifunctional management approach.

Objectives

The main objective of the project is to understand the relationships between Mediterranean oak forest decline and the fluctuation of environmental factors. Assuming a good association between environmental factors and oak forest health, we will model the potential trends under global change scenarios. Specifically, we will build on the modelling studies developed at regional scale (Hernández-Lambraño et al. 2016, 2018, Camilo-Alves et al. 2020) incorporating both ground and remote sensing data to establish a comprehensive modelling framework of oak forest decline across the Mediterranean Basin.

Methodology

We will review and develop a tree mortality and defoliation model for Mediterranean oak forests to predict decline outbreaks in accordance with fluctuation of environmental factors and potential distribution of *P. cinnamomi* (soil-borne non-native pathogen). Tree health data will be collated from forest health inventories at regional and continental scale

(including the UNECE ICP network). For this study we will select those plots dominated by *Quercus* spp. within the Mediterranean region (>50% of total forest cover) and with a sparse tree cover (20-75%). Each plot will be characterised with the health indicators (defoliation and mortality) and growth and structure information (e.g. age, tree cover, density, and basal area). Following Neumann et al. (2017) a tree will be considered dead for a certain year if it shows full defoliation and is not recorded in the following year.

Environmental data will be obtained at European scale from different source of data. Temperature and precipitation will be extracted primarily from ERA5 project (https://cds.climate.copernicus.eu/) with a temporal coverage from 1979 to present. Topographic information will be derived from digital elevation models at European scale. Finally, we will consider habitat suitability of the soil pathogen derived from a European potential distribution model of the species based on static abiotic information (Duque-Lazo et al. 2016).

Two different set of models will be considered, a) generalized linear models (GLM) and b) generalized additive models (GAM) (e.g. Carnicer et al. 2011). These models will be extended to include random effects (GLMM and GAMM, respectively) if it is necessary to account for spatial or habitat clustering in the dataset.

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