

## How management systems affect soil quality of cork oak woodlands? A case study of south Portugal



ARodrigues

### Keywords

cork oak

Quercus suber

management system

organic carbon

nitrogen

bulk density

soil fertility

### NWFP

Cork

### Scale

Subnational



### Context

Cork oak woodlands are currently facing a significant vitality decline, mainly due to inappropriate management practices, and the occurrence of extremes events (e.g., more frequent and intense drought periods) promoted by climate changes in the Mediterranean basin. In this sense, understanding how management practices influence soil quality, particularly organic carbon (C) and nitrogen (N) accumulation and dynamics, becomes crucial to warrant cork oak woodlands long-term sustainability and profitability, with direct economic benefits for landowners and the cork industry.



### Objective

Evaluate and compare physical, chemical and biochemical soil properties, regarding soil organic matter accumulation and soil fertility development, in cork oak woodlands, located in south Portugal, managed with two different systems: 1) a 5-year old improved pasture grazed by cattle, and 2) a natural understorey with shrubs control every 4-6 years (rotary mower), ensuring cork oak seedling are protected by adjusting cutting height to a maximum distance to soil surface, and preventing sapling damage by postponing this operation in shrub patches where natural regeneration is identified.



## Results

Improved pasture system leads to an increase of herbaceous vegetation, especially legume species, and to the removal of shrubs. The improved pasture management did not increase soil organic C stock (0.7 kg m<sup>-2</sup> decrease) but did enhance N accumulation in the upper 30 cm soil layer (39.7 g m<sup>-2</sup> increase), when compared with the natural understory system. The increase of nitrogen availability in the upper 10 cm soil layer was accompanied by a significant decrease of the soil C:N ratio in the improved pasture system (26 to 17).

Tree recruitment is hampered in the improved pasture system, while in the natural understorey management soil organic carbon conservation and tree recruitment facilitation were achieved.



## Recommendations

The sustainable management of cork oak woodlands must always be site-specific. Including practices that promote trees regeneration is crucial to ensure their long-term viability and resulting provision of raw cork material to the industry. Concerning soil quality amelioration, the observed soil fertility benefits associated with improved pastures establishment could be achieved through the application of chemical fertilizers. Policies supporting improved pasture sowing should be revised to include other management alternatives, as these soils C sequestration potential enhancement appears not guaranteed by pasture installation alone.



## Impacts and weaknesses

Despite the undeniable potential for soil fertility improvement, pasture sowing may not warrant soil organic C accumulation enhancement, under these cork oak woodland systems. In addition, tree recruitment facilitation practices are mostly absent under these pasture management systems, so their long-term sustainability remains uncertain. The effect of cattle grazing could not be disentangled from the pasture establishment, in this study.

The obtained information is useful for both land managers and policy-makers endeavoring management practices that ensure cork oak woodlands' future viability.



## Future developments

To improve knowledge of the most suitable management practices for cork oak woodlands, additional information on soil functions and services is required. Establishing permanent reference plots and developing longer-term studies will provide crucial information on soil functions and, cork production and quality variations under the ongoing climate and management changes.



Natural understorey vegetation; ARodrigues

### Further information

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#### About INCREDIBLE Project

INCREDIBLE project aims to show how Non-Wood Forest Products (NWFP) can play an important role in supporting sustainable forest management and rural development, by creating networks to share and exchange knowledge and expertise. 'Innovation Networks of Cork, Resins and Edibles in the Mediterranean basin' (INCREDIBLE) promotes cross-sectoral collaboration and innovation to highlight the value and potential of NWFPs in the region.

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