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Macrofungi and lichenised fungi as biological indicators: the case of Pyrenean oak and chestnut forests in Castilla y León (C-NW Iberian Peninsula)

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Introduction

The study of fungal diversity is very important for assessing ecosystem quality because fungi are involved in the recycling of organic matter and form symbiotic associations with plant species (Warnasuriya et al., 2023). In recent decades, fungi have been used as bioindicators to assess the conservation status of different habitats, as their sensitivity and adaptive capacity reflect environmental changes (Soares et al., 2022).

The aim of this study was to compare the diversity of macrofungi and lichenised fungi in Pyrenean oak and chestnut forests in the region of Castilla y León (Spain), in order to investigate their potential as bioindicators and analyse the implications of their presence in these ecosystems.

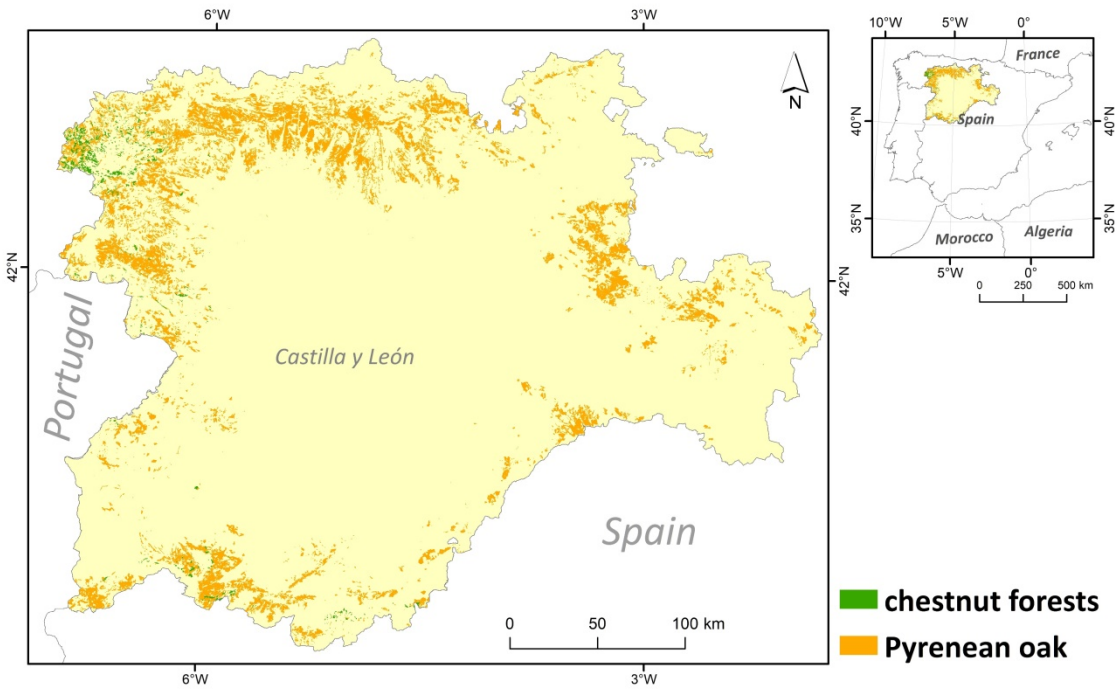

Figure 1. Distribution of Pyrenean oak and chestnut forests in C-NW Spain.

Materials and methods

The study area was adjusted to the chestnut forests and the Pyrenean oak present in Castilla y León (C-NW of Spain) (Fig. 1). To analyse the data, we used the digital cartography of the Forestry Map of Spain at a scale of 1:25,000 (MFE25, 2022) and the species citations were obtained from GBIF (GBIF, 2022).

Species richness (alpha diversity) and similarity of fungal diversity (beta diversity, using Sørensen's index) were measured for these two ecosystems.

The way of life of the macrofungi and the habit and pollution sensitivity of the lichens were used to evaluate the general health status of these ecosystems. For this purpose, the percentages of representation of these parameters were valued.

Results

Table 1. Relationship between the number of species of macrofungi and lichenised fungi and the area of Pyrenean oak and chestnut forests in Castilla y León. Nº. spp.=number of species; ha=hectares.

	Nº SPP. PYRENEAN OAK	Nº SPP./HA PYRENEAN OAK	Nº SPP. CHESTNUT FORESTS	Nº SPP./HA CHESTNUT FORESTS
Macrofungi	560	0,001027	127	0,006513
Lichenised fungi	526	0,000965	85	0,004356

Table 2. Beta diversity among the Pyrenean oak and chestnut forests of Castilla y León, both macrofungi and lichenised fungi.

	Nº SPP. PYRENEAN OAK	Nº SPP. CHESTNUT FORESTS	Nº COMMON SPP.	SØRENSEN'S INDEX
Macrofungi	560	127	87	0,2533
Lichenised fungi	526	85	79	0,2586

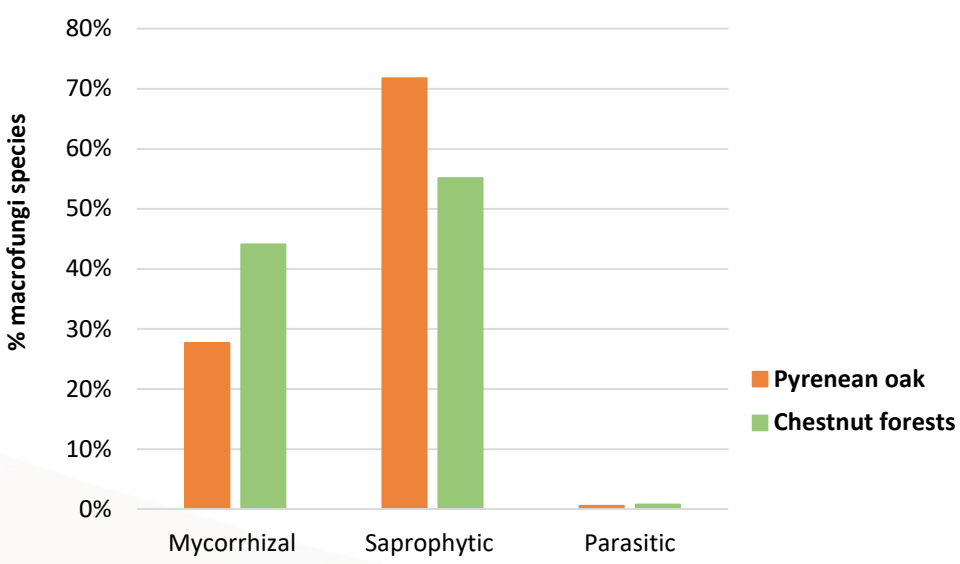

Figure 2. Percentage of species of macrofungi of each way of life in Pyrenean oak and chestnut forests.

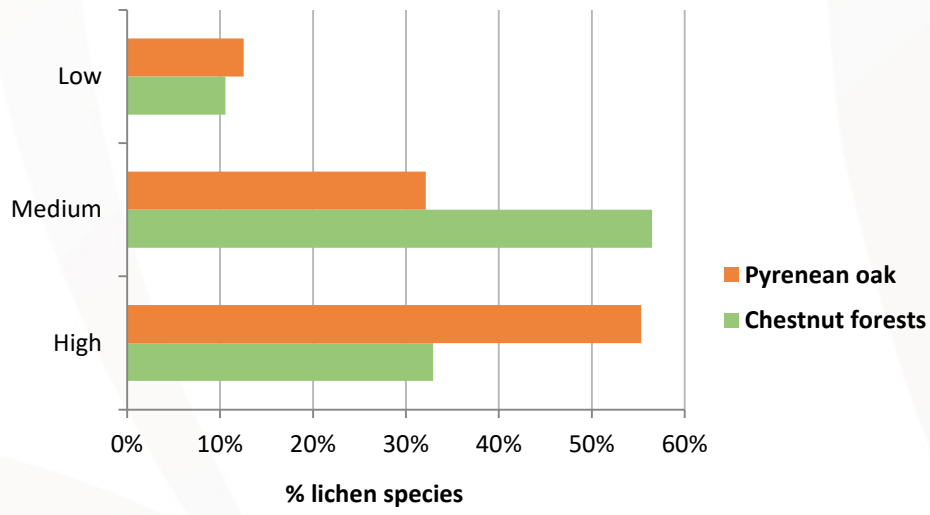

Figure 3. Percentage of lichen species according to their sensitivity to pollution in chestnut forests and Pyrenean oak.

Discussion

The Pyrenean oak and chestnut forests of Castilla y León are home to a high fungal diversity (Table 1). However, they show differences in fungal composition (Table 2), probably because they are dominated by different tree species (González-Montelongo & Pérez-Vargas, 2021).

In terms of conservation status, the high percentage of saprophytic macrofungi in the Pyrenean oak (Fig. 2) could indicate that they are not in an optimal conservation status, possibly because they are more used for livestock (Sanz et al., 2022). However, the presence of lichenised fungi more vulnerable to pollution in the Pyrenean oak (Fig. 3) indicates that these areas have better air quality. In contrast, the composition of lichen species in chestnut forests shows lower air purity, which may be due to the fact that these forest formations are closer to urban centres for their use (Roces-Díaz et al., 2018).

Fungal diversity can reflect the health of ecosystems, demonstrating the usefulness of fungi as bioindicators.

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