Distribution Patterns of *Quercus ilex* from Last Interglacial to the Future by Ecological Niche Modelling

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May 16, 2023

Abstract

The plants' geographical distribution is affected by natural or human-induced climate change. Numerous studies at both the global and regional level currently focus on the potential changes in plant distribution areas. Ecological niche modeling can help predict the likely distribution of species according to environmental variables under different climate scenarios. In this study, we predicted the potential geographic distributions of *Quercus ilex* L. (holm oak), a keystone species of the Mediterranean ecosystem, for the Last Interglacial period (LIG: ˜120 Ka), the Last Glacial Maximum (LGM: ˜22 Ka), mid-Holocene (MH: ˜6 Ka), and future climate scenarios (Representative Concentration Pathway (RCP) 4.5 and 8.5 scenarios) for years 2050-2070 obtained from CCSM4 and MIROC-ESM global climate scenarios respectively. The models were produced with algorithms from the R-package "biomod2" and assessed by AUC of the Receiver Operating Characteristic plot and True Skill Statistics. Apart from BIOCLIM (SRE), all model algorithms performed similarly and produced projections that are supported by good evaluation scores, although Random Forest (RF) slightly outperformed all the others. Additionally, distribution maps generated for the past period were validated through a comparison with pollen data acquired from the Neotoma Pollen Database. The results revealed that southern areas of the Mediterranean Basin, particularly coastal regions, served as long-term refugia for *Q. ilex*, which was supported by fossil pollen data. Furthermore, the models suggest long term refugia role for Anatolia and we argue that Anatolia may have served as a founding population for the species. Future climate scenarios indicated that *Q. ilex* distribution varied by region, with some areas experiencing range contractions and others range expands. This study provides significant insights into the vulnerability of the *Q. ilex* to future climate change in the Mediterranean ecosystem and highlights the crucial role of Anatolia in the species' historical distribution.

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