
Using past climate change data and niche modeling to predict the past, modern and future distribution of Atlas cedar forests in Morocco

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Abstract

An extended dataset of pollen records from the Middle Atlas shows that Atlas cedars (*Cedrus atlantica*) were present over the past 20,000 years. A genetic study of 17 populations from the Rif, the Middle and the High Atlas Mountains indicates that there is a weak genetic structuring with low gene flow between populations which suggests that the species did not propagate from a specific glacial refugium, but rather that populations persisted in different mountain areas from which they colonized higher altitude habitats. The long term persistence of Atlas cedar populations within the same area may explain the weak genetic structure and the lack of refugium specific ancestors found in its modern range.

Reconstructed past climates in Morocco show that the Middle Atlas was not under a typical Mediterranean climate. Using a niche-based model we hindcasted its range for the last glacial period and compared it to fossil pollen data. Then we have a potential glacial range based on a fossil pollen dataset along with a simulated climate from GCMs, to predict the modern range. These simulations show that the hindcasted range is more coherent with the fossil pollen data than the predicted modern distribution.

The modern range of Atlas cedars in Morocco is an interglacial refugium state which corresponds more to a reduced realized niche compared to the glacial range than to an expanded realized niche. Using the modern range for future predictions should thus be used with great caution.

Keywords: *Cedrus atlantica*, Morocco, fossil records, niche modelling, past climate reconstruction

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