

Mixed conifer and beech forests complement each other in the use of resources, unless rainfall is low

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Complementarity between Scots pine and broad-leafed species in the use of available resources such as water may increase the growth of mixed forests comprising both species compared with pure forests with only one. However, the lack of rainwater reduces this advantage in species that, like the Scots pine, do not tolerate shade, because increased competition for water does not allow them to compete for light.

On the other hand, the effect of growing in a mixed forest is less important for highly competitive and shade-tolerant species like the beech. This is one of the conclusions reached by researchers at the Public University of Navarre (NUP/UPNA) and the Instituto Pirenaico de Ecología (Pyrenean Institute of Ecology) of the Spanish National Research Council (CSIC) after studying both species in the Navarrese Pyrenees using data going back three decades. Their work is included in an article published in the *Journal of Ecology*.

"Mixed forests of conifers and broadleaf trees are increasingly regarded as ecosystems that could provide strategies for adapting forestry management to climate change," said Ester González de Andrés, lead author of the article.

Yet in these mixed forests, "little is known about the combined effects of competition between individual trees, the increase in the concentration of atmospheric CO₂, and climate," added Juan A. Blanco.

Data from the Navarrese Pyrenees

To shed light on this question, NUP/UPNA and CSIC researchers reconstructed chronologies using data obtained over 34 years (from 1980 to 2013) on annual growth and efficiency in water use in two mixed forests of Scots pine and beech in the Pyrenees located in the Navarrese towns of Aspurz and Garde. They also gathered information on tree to tree competition (measured as the number of neighbouring specimens and the distances from them to each of the trees studied) and the climate variables provided by nearby weather stations.

"Our work shows how the growth of the two species declined when competition between individuals of the same species increased," explained Ester González de Andrés. "The Scots pine benefited from the presence of the beech because there was complementarity between them in the forest located in Garde at a higher altitude and with higher rainfall, but not in the drier forest of Aspurz. Yet the beeches did not display any significant response to the presence of the pine trees in the same forest probably because they are naturally highly competitive and can survive in shady environments created by pines as well as by other beech trees."

Efficient in water use

The researchers also discovered that the increase in competition between species modified efficiency in water use. "Although the [pine trees](#) are more efficient in the use of water than the beeches," said Juan A. Blanco, "over the last few years, the beeches have become more efficient, apparently to adapt better to dry spells. This has been translated into an increase in growth in the [forest](#) of Aspurz, more likely to be affected by drought."

In the view of the authors of the article, these behaviours have repercussions on the way mixed forests withstand drought, which is expected to increase owing to climate change. "This would take place, above all, in the forests located on the southern limit of the distribution of these species, as is the case of the one located in Aspurz. That is why the effects of [species](#) complementarity and their relationship with climate need to be taken into consideration to avoid overestimating the degree of atmospheric carbon fixation that can be carried out by mixed forests of conifers and broadleaved [trees](#)," said Ester González de Andrés.

More information: Ester Gonzalez de Andres et al. Tree-to-tree competition in mixed European beech-Scots pine forests has different impacts on growth and water-use efficiency depending on site conditions, *Journal of Ecology* (2017). [DOI: 10.1111/1365-2745.12813](https://doi.org/10.1111/1365-2745.12813)

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