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Future forests: Which tree species can survive climate change?

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Climate change has already had a profound impact on Europe's forests, leading to the death of thousands of hectares of trees due to drought and bark beetle infestations. A recent study conducted by researchers from the University of Vienna and the Technical University of Munich (TUM) has explored the future of reforestation in light of these challenges.

The experts identified a limited number of tree species that are viable for future forests, emphasizing the importance of mixed forests for ecosystem resilience.

Enormous decline of tree species

European forests, which traditionally feature a variety of tree species, have fewer types of trees compared to similar climatic regions in North America or East Asia. This diversity is expected to diminish

tree species may not be able to withstand future climatic conditions.

“This is an enormous decline, especially when you consider that only some of the species are of interest for forestry,” said lead author Wessely, an expert in conservation biology at Vienna.

Suitability of future tree species

The study evaluated the resilience of the most common 69 out of over 100 European tree species against the backdrop of 21st-century climate projections. On average, only nine of these species per location are deemed suitable for future conditions, with even fewer (four) in the UK, where species like the English oak are considered viable.

The suitability of tree species for future climates varies significantly across different regions of Europe.

Sustaining species-rich mixed forests

The research highlights a significant concern: even with a selection of climate-adapted trees, the diversity is insufficient to sustain species-rich mixed forests, which are crucial for enhancing forest robustness against disturbances like bark beetles.

“Mixed forests consisting of many tree species are an important measure to make forests more robust against disturbances such as bark beetles. In some places in Europe, however, we could run out of tree species to establish such colorful mixed forests,” explained Rupert Seidl, a professor of ecosystem dynamics and forest resilience at TUM.

Protecting future forests

Furthermore, not all trees are equally capable of fulfilling essential forest functions such as carbon storage, providing habitats or food for wildlife, or being used as timber. Only an average of three out of the nine suitable species can meet these needs.

"Our work clearly shows how severely the vitality of forests is affected by climate change. We cannot rely solely on a new mix of tree species; rapid measures to mitigate climate change are essential for the sustainable protection of our forests," Wessely concluded.

More about future forests

Forests of the future are anticipated to undergo significant transformations due to climate change, human activities, and technological advancements.

Shifting tree species

As global temperatures rise, the distribution of various tree species is expected to shift. For instance, species adapted to cooler climates may move toward higher altitudes or latitudes, while those tolerant of warmer conditions could expand their range. This shift will alter forest biodiversity and could lead to new compositions of plant and animal communities.

Pests and diseases

Additionally, forests are likely to face increased threats from pests and diseases, which can spread more rapidly in warmer conditions. This could result in higher tree mortality rates and altered forest landscapes. In response, forest management practices are expected to evolve.

Techniques such as assisted migration, where tree species are intentionally moved to areas where they are expected to thrive under future climatic conditions, could become more common.

Shaping future forests

Technological advancements will also play a crucial role in shaping the forests of the future. Innovations in drone technology and satellite imaging will improve monitoring of forest health and growth, enabling more precise and effective conservation strategies.

The forests of the future will likely be quite different from those we know today, shaped by a combination of environmental changes, human interventions, and technological innovations. Their ability to adapt and thrive will be crucial for biodiversity conservation, climate regulation, and the myriad ecological services they provide.

The study is published in the journal *Nature Ecology & Evolution*.

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