Microscopic soil creatures could orchestrate massive tree migrations

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Warming temperatures are prompting some tree species in the Rocky Mountains to "migrate" to higher elevations in order to survive.

Researchers at the University of Tennessee, Knoxville, have discovered that tiny below-ground organisms play a role in this phenomenon—and could be used to encourage tree migration in order to preserve heat-sensitive species. Their work shows how these invisible biotic communities create "soil highways" for young trees, meaning they could determine how quickly species march uphill, if at all.

The newfound role of the soil microbiome—the collection of

microscopic bacteria, fungi and archaea that interact with plant roots—represents a turning point for research aimed at understanding and predicting where important tree species will reside in the future.

Just as human microbiome research is rapidly changing our perspectives on human health and behavior, the interactions between trees and their soil microbiomes may dramatically change how we think about the health and behavior of forests.

The study was recently published in the journal *Nature Ecology and Evolution*.

The researchers' goal was to better understand how plants will respond as temperatures rise.

"One general expectation is that tree ranges will gradually move toward higher elevations as mountain habitats get hotter," said Michael Van Nuland, the project's lead researcher and a doctoral student in UT's Department of Ecology and Evolutionary Biology. "It is easy to see the evidence with photographs that compare current and historical tree lines on mountainsides around the world. Most document that tree lines have ascended in the past century."

Van Nuland noted that trees are affected by more than just temperature. Much like humans, trees rely on the interactions they have with other living things, and especially with their microbiome.

But how will migrating trees react to soil microbiomes found at high elevations?

To find out, Van Nuland and colleagues collected soils beneath a common cottonwood species that covers several states in the Rocky Mountains. They scouted steep mountainsides where the tree species

currently lives and sites at higher elevations where the tree is likely to expand. They brought the soils and seedlings back to UT and simulated the expected tree movements by growing young trees with soils collected from across their elevation ranges. The results showed that trees near the base of the mountain grew better in their current soil than in soil from the top of the mountain. But the opposite was true for trees at higher elevations; they thrived in soil from much higher elevations.

"This indicates that we need to work with the trees near the bottom of the mountain, because they are the ones that will feel the most stress from warming temperatures," Van Nuland said. "So we have to figure out a way to coax them to move up."

The research could help scientists design specific groups of bacteria and fungi to encourage the migration of trees threatened by warming climates.

More information: Michael E. Van Nuland et al. Divergent plant–soil feedbacks could alter future elevation ranges and ecosystem dynamics, *Nature Ecology & Evolution* (2017). DOI: 10.1038/s41559-017-0150

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