Even plant-supporting soil fungi affected by global warming, study finds

March 7 2016

UCI graduate student Caitlin Looby is exploring the effects of global warming on the soil fungi communities of a mountain cloud forest in Monteverde, Costa Rica. UCI

On a cool, fog-shrouded mountain of Costa Rica, University of California, Irvine biologist Caitlin Looby is finding that warming temperatures are becoming an increasing problem for one of the most ecologically diverse places on Earth.

Seeking to determine how shifts in the tropical mountain cloud forest ecosystem would affect resident fungal species in Monteverde, Looby and fellow ecology & evolutionary biology graduate student Mia Maltz and their adviser, Kathleen Treseder, found that as the moist mountain soil dries out due to a warming climate, the fungi infrastructure that supports the abundant plant life also will change.

The impact on this ecosystem may be significant. Looby explained that if the higher-elevation soil becomes similar to lower-elevation soil (which is warmer and drier), it will spur the growth of the type of fungi flourishing at lower elevations that breaks down plant material. And if this degradation of plant material escalates, it will release significantly increased amounts of carbon dioxide—a greenhouse gas—into the atmosphere.

Open-access results of the study appear online in *Ecology & Evolution*.

Despite the fact that they make up less than 1 percent of the planet's land surface, tropical mountain cloud forests such as the one in Costa Rica that Looby studies contain 20 percent of the world's plant species and 16 percent of its vertebrate species.

The cloud layer is rising due to global warming, leading to drier conditions. Consequently, these ecosystems are undergoing rapid shifts as plant species either become extinct or are forced to follow their optimal climates to higher elevations.

"These mountains provide a unique opportunity to predict how soil fungi will change in response to climate," Looby said. "The properties of these mountain soils are sensitive to the rising cloud layer. Our work demonstrates that fungal community composition shifts with elevation and with climatic factors that co-vary with belowground responses to elevation, such as temperature and moisture."

Soil fungi and plants have developed a mutually beneficial arrangement. Some fungi help plants by growing into their root cells and increasing the root surface area available to absorb water and nutrients. In turn, plants give the fungi the sugars they crave. Other fungi facilitate the breakdown of plant material, which releases carbon dioxide.

Looby said the larger implication of this elevation-gradient research is that it can add to our understanding of the roles that temperature and moisture play in influencing belowground communities and processes. This could allow for better predictions of how tropical ecosystems will respond to global warming.

"Any changes in climate could have important ecological consequences by potentially altering how these communities are structured and by altering the responses of important belowground processes that may mitigate or accentuate climate change," Looby said.

More information: *Ecology & Evolution*, onlinelibrary.wiley.com/doi/10.1002/ece3.2025/epdf