

Climate Clues in Mushrooms

To learn how carbon dioxide affects lawns, researchers look to mushrooms

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WHEN UNH RESEARCHERS SET OUT TO DETERMINE HOW RISING CARBON DIOXIDE CONCENTRATIONS AND DIFFERENT CLIMATES MAY ALTER THE 40 MILLION ACRES OF AMERICAN LAWNS, THEY FOUND THAT THE CLUES IN AN UNEXPECTED SOURCE: MUSHROOMS. PHOTO COURTESY OF MICHAEL KUO.

Since the Industrial Revolution, the amount of carbon dioxide in the atmosphere has rapidly increased. UNH researchers

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set out to determine how rising carbon dioxide concentrations and different climates may alter vegetation like forests, croplands, and 40 million acres of American lawns. They found that the clues may lie in an unexpected source: mushrooms.



AMANITA THIERSI. PHOTO COURTESY OF JOE MCFARLAND.

The researchers, led by Erik Hobbie of UNH's [Institute for the Study of Earth, Oceans, and Space \(EOS\)](#), focused on American lawns because they knew that grass can play a key role in the global carbon cycle. Grass pulls carbon out of the atmosphere during photosynthesis, the process used by plants to absorb and harness energy from sunlight and convert it into chemical energy. Most lawns across the United States are similar, but differ regionally in their relative proportions of two main types of grasses, C₃ grasses and C₄ grasses, which use different metabolic pathways for photosynthesis. However, unlike trees, which build rings year after year, grass leaves little behind to study, so researchers got creative, turning to mushrooms, which feed on the carbon in lawns.

“We thought that mushrooms could be a valuable indicator of responses of lawns to carbon dioxide levels in ecosystems because they feed on the dead grass and debris, or carbon, that lawns or other plants put into the ground,” says Hobbie, research professor of terrestrial ecology and lead author on the study.

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This novel method — looking to mushrooms to study how vegetation landscapes have changed over time — could be used in the future to assess how grasslands are adapting to climate change and increasing carbon dioxide concentrations.

In the [study](#), published in the Journal of Geophysical Research:

Biogeosciences and featured in the American Geophysical Union’s magazine [Eos](#), Hobbie, UNH professor of statistics Ernst Linder, and their colleagues looked at isotopic data from samples of the mushroom *Amanita thiersii* collected between 1982 and 2009 from 26

locations in the southeastern and south central United States. The scientists combined these data with information on temperature, precipitation, and carbon dioxide concentrations over the same period to look at competition between the two kinds of grass, C₃ and C₄.

C₃ grasses, such as wheat, oats, and ryegrass, are called cool-season plants and thrive in a temperature range of 65°–75°

Fahrenheit. C₄ plants, which include corn, crabgrass, and bluestem grasses, flourish in warmer and drier environments.

These warm-season plants and are more efficient than C₃ plants at photosynthesis under low concentrations of carbon dioxide.

Researchers found that the *Amanita thiersii* appeared to be good integrators of the carbon in lawn grasses. Temperature was the dominant climatic influence over C₃ versus C₄ grass distribution. As carbon dioxide in the atmosphere increased over those decades between 1982 and 2009 and temperatures rose, changes in grass competition and growth were reflected in the carbon of *Amanita thiersii*. With every 1°C increase in temperature, the proportion of carbon from C₃ grasses, as found in the *Amanita thiersii*, decreased by 12%. But researchers also found that the relative proportion of C₃ grasses increased by 18.5% in response to the increase in carbon dioxide concentrations from 341 to 387 parts per million.

This suggests that rising carbon dioxide is already influencing plant competition on the American landscape and that preserved specimens of plants and mushrooms could be used more widely to examine current responses to global change.

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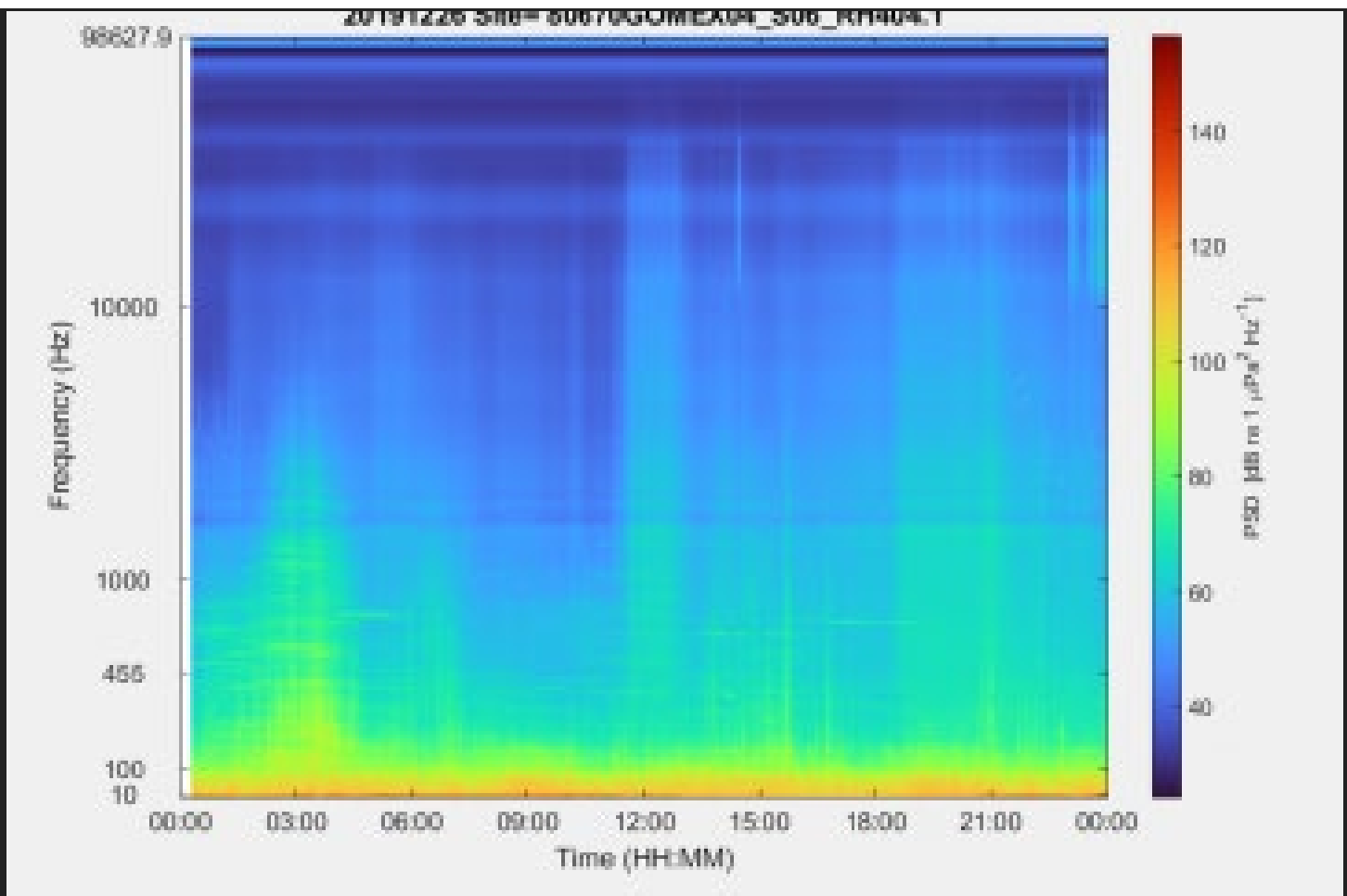
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