

Predators have outsized influence over habitats, research says

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This is a grasshopper in the field. Credit: The Hebrew University of Jerusalem

A grasshopper's change in diet to high-energy carbohydrates while being hunted by spiders may affect the way soil releases carbon dioxide into the atmosphere, according to Yale and Hebrew University researchers in *Science*.

Grasshoppers like to munch on nitrogen-rich grass because it stimulates their growth and reproduction. But when spiders enter the picture, grasshoppers cope with the stress from fear of [predation](#) by shifting to carbohydrate-rich plants, setting in motion dynamic changes to the ecosystem they inhabit.

"Under [stressful conditions](#) they go to different parts of the [grocery store](#) and choose different foods, changing the makeup of the plant

community," said Oswald Schmitz, a co-author of the study, "Fear of Predation Slows Plant-Litter [Decomposition](#)," and Oastler Professor of Population and Community Ecology at the Yale School of Forestry & Environmental Studies (F&ES).

The high-energy, [carbohydrate](#) diet also tilts a grasshopper's body chemistry toward carbon at the expense of nitrogen. So when a grasshopper dies, its carcass breaks down more slowly, thus depriving the soil of high-quality fertilizer and slowing the decomposition of uneaten plants. Microbes in the soil require a lot of nitrogen to function and to produce the enzymes that break down [organic matter](#).

"It only takes a slight change in the chemical composition of that animal biomass to fundamentally alter how much [carbon dioxide](#) the microbial pool is releasing to the atmosphere while it is decomposing plant organic matter," said Schmitz. "So this shows that animals could potentially have huge effects on the global carbon balance because they're changing the way microbes respire organic matter."

The researchers found that the rate at which the organic matter of leaves decomposed increased between 60 percent and 200 percent in stress-free conditions relative to stressed conditions, which they consider "huge."

"Climate and litter quality are considered the main controls on organic-matter decomposition, but we show that aboveground predators change how soil microbes break down organic matter," said Mark Bradford, a co-author of the study and assistant professor of terrestrial ecosystem ecology at F&ES.

Schmitz added: "What it means is that we're not paying enough attention to the control that animals have over what we view as a classically important process in ecosystem functioning."

The researchers took soil from the field, put it in test tubes and ground

up grasshopper carcasses obtained either from predation or predation-free environments. They then sprinkled the powder atop the soil, where the microbes digested it. When the [grasshopper](#) carcasses were completely decomposed, the researchers added leaf litter and then measured the rate of leaf-litter decomposition. The experiment was then replicated in the field at Yale Myers Forest in northeastern Connecticut.

"It was a two-stage process where the grasshoppers were used to prime the soil, and then we measured the consequences of that priming," said Schmitz.

Schmitz said that the effect of animals on ecosystems is disproportionately larger than their biomass would suggest.

"Traditionally people have thought animals had no important role in recycling of organic matter, because their biomass is relatively small to all of that plant material that's entering ecosystems," he said. "We need to pay more attention to the role of animals because in an era of biodiversity loss we're losing many top predators and larger herbivores from ecosystems."

More information: "Fear of Predation Slows Plant-Litter Decomposition," by D. Hawlena, *Science*, 2012.

Provided by Yale University

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