

# Study offers new paradigm on ecosystem ecology



Grasshopper, *Melanoplus femurrubrum*

**Predators have considerably more influence than plants over how an ecosystem functions, according to a Yale study published today in *Science*.**

The findings, according to the author, Oswald Schmitz, Oastler Professor of Population and Community Ecology at the Yale School of Forestry & Environmental Studies, are a “revolutionary” shift in thinking on the subject. Ecosystem ecologists have long held that plants and their interaction with the soil determine the type and abundance of herbivores and carnivores in an ecosystem. Schmitz’s paper, “Effects of Predator Hunting Mode on Grassland Ecosystem Function,” shows that the opposite is true.

“Most ecosystem ecologists think that the supply of nutrients in plants determines who can live up in higher trophic (feeding) levels,” said Schmitz. “This study shows that it’s the top trophic levels determining how the plants interact with the soil.”

In a three-year-long experiment conducted in 14 enclosed cages at Yale-Myers Forest in northeastern Connecticut, Schmitz observed that the jumping spider, known also by its Latin name *Phidippus rimator*, prowls its neighborhood, or ecosystem, and engages in random acts of violence against its plant-eating prey, the garden variety grasshopper (*Melanoplus femurrubrum*).

And much like victims of crime, grasshoppers facing an imminent threat go into a heightened state of alert, taking refuge in the ecosystem’s dominant plant, the goldenrod. Its mobility restricted, the grasshoppers dine on its own shelter, promoting habitat diversity in the process. The goldenrod’s competitors—Asters, Queen Anne’s Lace and a variety of clover and grasses—flourish, but the diversity comes at a price. With the demise of the goldenrod, nitrogen—a key fertilizer in the soil’s renewal—is depleted.

In a separate part of the experiment, nursery web spiders (*Pisaurina mira*), which Schmitz called “sit-and-wait ambush spiders” because they are coy about their predatory intentions, occupy a certain “bad neighborhood,” enabling grasshoppers to avoid them, roam the ecosystem and eat a wider variety of plants. In this milieu, the goldenrod thrives, ultimately nourishing the soil when its nitrogen-rich tissue decays.

“What’s really cool here is that different spiders have different hunting modes, and it’s those modes that cause grasshoppers to behave differently, which then carries down the chains of the community structure of the plants,” said Schmitz. “So it’s a top-down view and, in that sense, it’s revolutionary because it’s a paradigm change in ecosystem ecology. Plants, ecosystem ecologists say, have an indirect effect on carnivores. My research shows that carnivores have an indirect effect on plants.”

Schmitz said that the study’s underlying principles can apply to larger ecosystems, such as Yellowstone National Park, and have implications for conservation policies. “If elk are facing cougars, which are ambush predators, they’re going to change where they are on the landscape. Whereas when elk face wolves,

they may not change their location; they'll only respond to an imminent threat, because wolves are continually wandering around on the prowl."

He added, "We know that elk can have a huge impact on plant diversity and, as a consequence, nutrient cycling properties. And so by the way they use the landscape, depending on what predator they have, that will change the local ecosystem processes."

Source: Yale University

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