No defense for some plants in the eat-or-be-eaten world of grasslands

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If you're a gardener, you may not be too thrilled when insects, rabbits, fungi and other plant-eaters nibble their way through your world. But in two recent papers published in the journals *Ecology* and *Ecology Letters*, University of Minnesota researchers are showing the important role such plant-eating consumers play in an ecosystem's ability carry out key jobs like storing carbon—and, in turn, the role plants play in supporting these organisms and the others that depend on them. The research was carried out at the U's Cedar Creek Ecosystem Science Reserve, a field research station just north of the Twin Cities.

In the first paper, the researchers showed that insects and fungi removed about 40 percent of plant material each year—about one ton per acre of roots and leaves in low-diversity grasslands and three tons per acre in high-diversity grasslands. This plant material is what supports the diverse communities of insects, mammals, birds and microbes that rely on native prairies.

The second paper, which builds on this earlier research, describes the results of experiments aimed at exploring whether different plants were more adept at protecting themselves from different types of consumers.

"Studies usually just look at deer, or fungi, or insects," said Eric Seabloom, professor in the College of Biological Sciences and lead author of the second report. "We were looking for trade-offs. Are the plants that do well when you take away insects different from the ones that do well when you take away fungi or put up a fence to keep out mammals like deer?"

To find out, Seabloom and colleagues Elizabeth Borer and Linda Kinkel excluded soil fungi, leaf fungi, insects and larger animals in various combinations from different grassland plots using fungicides, insecticides and fences. Different plots had different numbers and kinds of plant species. The researchers then measured how much the various plants grew relative to how much they grew when consumers had access to them. They used the extra growth as an indicator of how good each plant species is at defending itself against the consumer or consumers being excluded.

To the researchers' surprise, different plants didn't face a trade-off in defending themselves against different consumers. For example, plants that were well defended against insects were also well defended against fungi and mammals. "It's less complicated than we thought," Seabloom said. "There are a bunch of plants that are just protected against everything, and there are plants that just get devoured."

The results suggest that insects, fungi and mammals that eat plants help support diversity by preventing certain groups of plants from outcompeting others. They also underscore how important plant diversity is to maintaining a rich variety of other organisms, which in turn support the rest of the ecosystem, including humans.

"We've told the pollinator story, but there are lots of other consumers that are declining due to changes in land use, and the use of fungicides and insecticides," Borer said. "This gives us some insights into what the future might look like. We're starting to put some numbers on what could happen to global systems that support our lives if we don't keep them healthy."

Cedar Creek researchers are now further exploring the relationship between plant diversity and consumers by reintroducing bison, which historically roamed the region, to parts of the Cedar Creek research station.

"The bison will help us better understand how plants differ in their susceptibility to consumers and how herbivores can help maintain diversity and restore native ecosystems," Seabloom said.

More information: Eric W. Seabloom et al. No evidence for trade-offs in plant responses to consumer food web manipulations, *Ecology* (2018). DOI: 10.1002/ecy.2389

Eric W. Seabloom et al. Food webs obscure the strength of plant diversity effects on primary productivity, *Ecology Letters* (2017). DOI: 10.1111/ele.12754

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