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NEWS

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Biocontrol Insect Exacerbates Invasive Weed

Introduced flies create complex interactions that increase impact of invasive plants

Biocontrol agents, such as insects, are often released outside of their native ranges to control invasive plants. But scientists in Montana have found that through complex community interactions among deer mice, native plants and seeds, the presence of an introduced fly may exacerbate the effects of the invasive plant it was meant to control. The authors report their results in the September issue of the journal *Ecological Applications*.

Spotted knapweed, a flowering plant native to Eurasia, was first discovered in the United States in the late 1800s. This broad-leaved plant has an advantage over native plants because its natural enemies, including insects such as European gallflies, do not naturally exist in North America. Thought to have hitched a ride with hauls of alfalfa, knapweed is now widespread in western North America and has become a serious problem in the U.S. across Washington, Idaho, Wyoming and Montana and in Canada across Alberta and British Columbia.

As early as 1971, U.S. scientists began releasing gallflies in an effort to reduce populations of the invasive weed. Like all biocontrol agents, the gallflies were selected because of their specificity to their host plant, leaving little risk of direct harm to other plants.

Adult flies lay their eggs in the weed's flowers, and after the larvae hatch they induce the plant to grow tissue around the insect, encasing it and isolating it from the rest of the plant.

"The woody galls wall off the fly larvae from within flower head," says Dean Pearson, lead author on the study and a research ecologist with the U.S.D.A. Forest Service's Rocky Mountain Research station. "The larvae then overwinter in the seed heads for about nine months. When the plant devotes all that extra energy to producing these galls, it has less energy to produce seeds."

Scientists and managers expected that this seed deficiency would lead to limited knapweed population growth. An unanticipated side effect, however, involves the flies' furry neighbors. At the foot of the Sapphire Mountains in western Montana, omnivorous deer mice, whose diet usually consists of native seeds and insects, have also begun to prey on the introduced gallflies.

"These mice are generalists and very effective at exploiting a new resource," says Pearson. "They can tell which seed heads have the most larvae inside them, and that makes them very efficient." Pearson says that an average mouse can process 1200 larvae in one night. "A super mouse could go through a whole lot more than that," he adds.

At Pearson's grassland study site, spotted knapweed makes up more than half of the plant ground cover. The abundance of knapweed leads to lots of gallfly larvae, which serve as a food subsidy for the mice. Pearson and his coauthor, Ragan Callaway of the University of Montana, found that this extra nourishment bolsters mouse population size, increasing the numbers of hungry mice feeding on their

original source of food: the seeds of native plants. As mouse consumption of native plant seeds increases, fewer native plants survive past the seed stage.

Pearson says that this exacerbation of the invasive species' impact has a lot to do with the effectiveness of the fly at controlling the knapweed.

"If the biocontrol agent is really effective, then it will eventually eat itself out of house and home, and the community interactions become less of an issue," Pearson says. He points out that even if the fly decimates 80 percent of the knapweed population, the 20 percent of seeds that are left to germinate are often enough to outcompete native plants.

The authors make the case that although biocontrol agents are carefully selected for specificity to their host plants, these restrictions do not prevent them from drastically altering the community food web, which can have far-reaching repercussions. Pearson hopes that a better understanding of food web ecology will lead to more effective tools for invasion control.

"Everything's interconnected," says Pearson. "We need to understand the ecology. If we can understand these complexities, we can attempt to minimize the side effects and maximize the effectiveness of our tools."

To listen to a podcast of Pearson speaking about this paper in ESA's Field Talk podcast series, please visit www.esa.org/podcast. Pearson's podcast is titled "Biocontrol Insects and the Mammals Who Love Them."
