Global plant diversity still hinges on local battles against invasives, study suggests

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Kristin Powell measuring out a study plot of invasive flax lilies in Highlands Hammock State Park in Florida. Created in 1935 Highlands Hammock is one of the first state parks to be created in Florida. In an oft-repeated tale, the lily now invading the park escaped from a botanical garden once on park grounds. (JESSICA POWELL)

(Phys.org)—In Missouri forests, dense thickets of invasive honeysuckle decrease the light available to other plants, hog the attention of

pollinators, and offer nutrient-stingy berries to migrating birds. They even release toxins to make it less likely native plants will germinate near them.

Why, then, are recent popular science articles recommending a recalibration of the traditional no-tolerance attitude toward non-native species, suggesting that we've been "unfair" to invasives and should stop "persecuting" them?

Kristin Powell, a graduate student in the lab of Tiffany Knight, associate professor of biology and director of the Environmental Studies Program in Arts & Sciences, together with consulting ecologist Jon Chase, think they've located one source of misunderstanding.

Most scientific studies of the effects of invasive plants are done at a single "scale." Some studies scrutinize biodiversity in meter-square "quadrats" and others scan biodiversity in entire islands or regions.

The problem, the scientists say in the January 18 issue of *Science*, is that the effect of invasive plants on species richness depends on scale. Invasives decrease species richness at small but not at large scales.

The recognition that findings are scale dependent reconciles at least some dueling scientific studies. "I won't say we've resolved the debate, but I think we've made an important contribution," Knight says.

Whether it will stop journalists from interpreting a quarrel over nuance as a complete reversal of opinion is another question, given the powerful editorial attraction to man-bites-dog stories.

Probing for scale dependence

The three scientists had long suspected that studies of invasive species

came to different conclusions because of scale dependence. To test this notion, they analyzed 57 previous invasive studies and confirmed a pattern: invasive plants cause a large loss in species richness at small scales, but this effect diminishes at larger scales.

To test for scale dependence in the field, they then chose three study sites from very different ecosystems across the United States, each straddling an invasion front: a hammock forest in central Florida; an oak-hickory forest in eastern Missouri; and a tropical forest on the Big Island of Hawai'i.
The hammock forest, a mix of live oak, cabbage palm, sweet gum and pignut hickory, is being invaded by the flax lily (Dianella ensifolia). Native to Africa and Asia, the lily forms dense mats on the forest floor.

Amur honeysuckle (Lonicera maackii), a mid-story shrub introduced from East Asia as an ornamental and to provide bird habitat, is the black hat in the oak-hickory forests.

The fire tree (Morella faya), a canopy tree from Macaronesia that boosts nitrogen levels in the soil, making it inhospitable to native species and more suitable for other invasives, is the troublemaker in the Hawaiian forest.

Invasives don't just sweep the board

"We counted the number of species per unit area in plots that varied in size from one meter square to 500 meters square—a quarter the size of a football field—on either side of the invasion front, and then plotted the number of species against the size of the plot," Powell says.

"At small scales, invaded plots had many fewer species than uninvaded plots, but they picked up species more rapidly, and at broad scales the invasives' effect on diversity virtually disappeared," Powell says.

The main reason for this "scale effect" is just probability, says Powell. "Invasives reduce the sheer number of individual plants in a plot and if there are fewer plants, you'll find fewer species," she says.

The invaded sites can catch up with uninvaded ones, Knight adds, because the number of species does not increase indefinitely.

"At any site, if you sample larger and larger areas, the number of species will eventually plateau. You can keep sampling all you want and you're not going to find any new species because you've found every species that's present in that ecosystem type," Knight says.

At an invaded site, you reach that plateau later, but you do reach it eventually.

What it means for gardeners

The research helps to explain seemingly contradictory findings in the scientific literature, but what does it mean for people who have been hacking down honeysuckle in their backyards and brushing their boots before entering conservation areas to avoid bringing in garlic mustard?

Is it worth whacking invasives or not?

"Emphatically yes," Knight says. "Invasive species are a serious threat," Knight says, "and if we're going to deal with them we need the cooperation of the public. Invasive plants have negative impacts on plant communities at smaller scales—the scales that are crucial for necessary ecosystem services, like water management and nutrient cycling."

Take that bush honeysuckle choking Missouri's natural areas, for example. It was seeded by birds carrying honeysuckle berries from backyards. To prevent it from turning beloved nature preserves into

shrub monocultures, people must remove it from their yards or choose not to plant it in the first place.

While the small scale justifies the fight, the large scale offers hope.

"Invasive plant species are reducing the abundance of native plant species, but most species are still present when we search for them at broad spatial scales. That is to say, they haven't gone extinct yet," Knight says.

"This means it is not too late to restore the habitat and increase the abundances of these native species so that they can contribute to critical ecosystem services and are less vulnerable to extinction in the future," she says.

More information: "Invasive Plants Have Scale-Dependent Effects on Diversity by Altering Species-Area Relationships," by K.I. Powell et al. *Science*, 2013.

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