New approach boosts effort to scale up biodiversity monitoring

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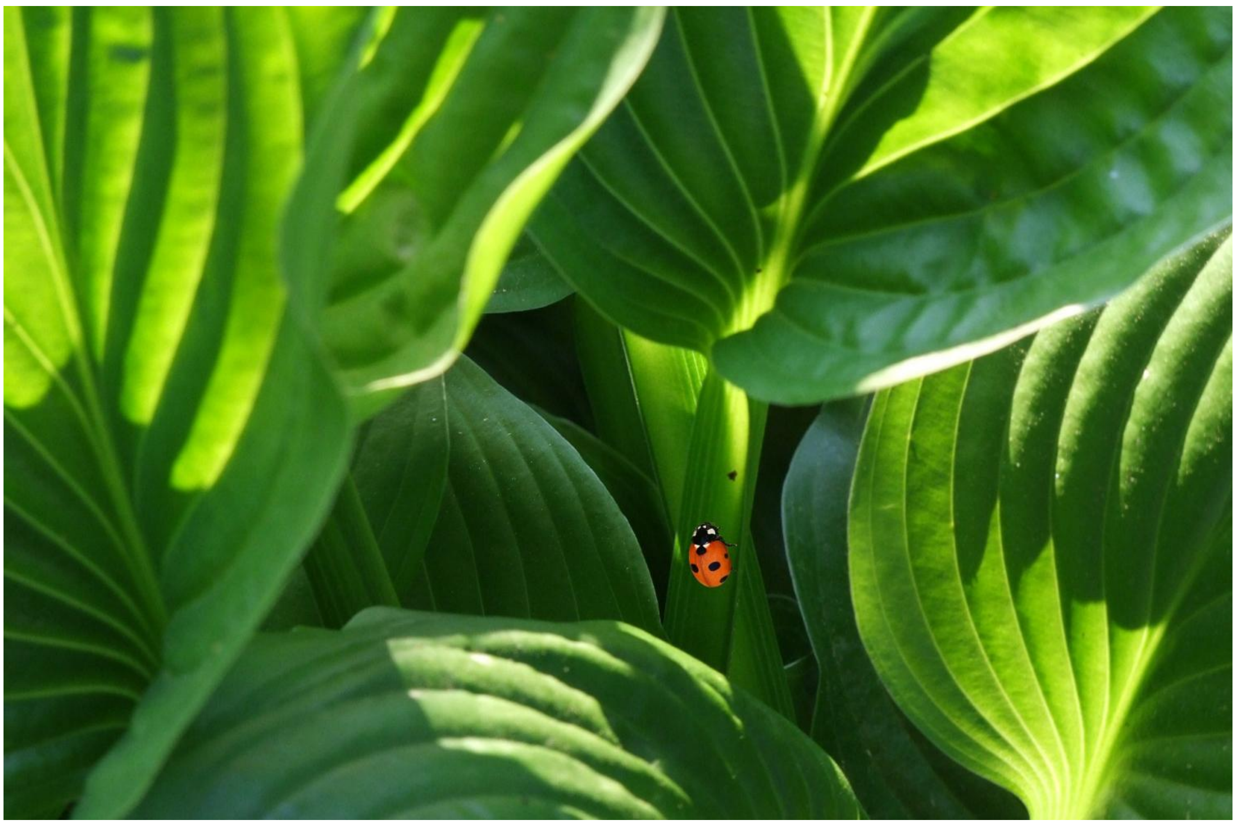

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The value of ecological biodiversity for maintaining ecosystem stability and function is well established, but a recent study points to a novel way to fine-tune our ability to measure it at larger scales. The study, published in *Nature Ecology and Evolution*, found that using an imaging tool to evaluate biodiversity is more effective than traditional methods premised on painstaking field work.

Lead author Anna Schweiger, a postdoctoral associate in the College of Biological Sciences, and a team of fellow researchers, used spectra of light reflected from plants to evaluate biodiversity and predict ecosystem function.

"We have known for decades that the chemical composition of plants can be estimated from reflectance spectra," said Schweiger. "What we found is that the spectral dissimilarity, or the overall differences in spectral reflectance, among plant species increases with their functional dissimilarity and evolutionary divergence time."

For the study, the team first measured the light reflectance of plants in 35 plots at Cedar Creek Ecosystem Science Reserve—a field station north of Minneapolis famous for long-term ecological experiments—using a field spectrometer. The spectrometer allows the researchers to evaluate how much light plants reflect at the leaf level across a range of wavelengths. By taking the leaf-level data the team found that the spectral diversity of a plant community predicted aboveground productivity, a critical ecosystem function, to a similar or higher degree than measures of species functional differences, their phylogenetic distances on the tree of life or the number of species in a plant community.

Seeing that the ecosystem effect of plant diversity can be effectively evaluated using spectrometry, the team also wanted to know if they could scale it up. By using an imaging spectrometer mounted three meters above ground at the same 35 plots at Cedar Creek and running a scan, they found that their spectral diversity metric performed similarly when calculated from spectral images.

"The findings indicate that spectral diversity provides a powerful, integrative method of assessing several dimensions of biodiversity relevant to ecosystem function," says co-author John Gamon, faculty member at the University of Nebraska-Lincoln.

This research is an element of a larger project led by senior author Jeannine Cavender-Bares, a professor in the College of Biological Sciences' Department of Ecology, Evolution and Behavior. With funding from a Dimensions of Biodiversity grant from NSF and NASA, the team aims to more completely understand how to predict ecosystem processes when comparing optical diversity to genetic, phylogenetic and functional diversity. The team's next step is to run an imaging spectrometry scan from a drone. The ability to scan from the sky offers new potential for researchers to further understand the ecosystem benefits of biodiversity, especially in difficult-to-reach locations.

"The rapid changes in the Earth's biodiversity that are underway require novel means of continuous and global detection," says Cavender-Bares. "This study demonstrates that we can detect plant biodiversity using spectral measurements from plant leaves or from the sky, which opens a whole new range of possibilities."

More information: Anna K. Schweiger et al, Plant spectral diversity integrates functional and phylogenetic components of biodiversity and predicts ecosystem function, *Nature Ecology & Evolution* (2018). DOI: 10.1038/s41559-018-0551-1

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