Researchers participate in network science to challenge long-held ecological theory

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(PhysOrg.com) -- For decades, ecologists have toiled to nail down general principles explaining why some habitats have so many more plant and animal species than others. Much of this debate is focused on the idea that the number of species is determined by the productivity of the habitat. Some would argue: Shouldn't a patch of prairie contain a different number of species than an arid steppe or an alpine tundra?

Maybe not, says an international team of scientists, including two faculty members from CSU, which pooled its resources to re-evaluate the relationship between species numbers and habitat productivity. Julia Klein, assistant professor in CSU's Department of Ecosystem Science & Sustainability in the Warner College of Natural Resources, and Cynthia Brown, associate professor in the Department of Bioagricultural Sciences and Pest Management in the College of Agricultural Sciences, were among the scientific team whose findings appear in the Sept. 23 issue of the journal *Science*.

Their innovative, standardized global sampling of 48 sites on five continents, which are part of the Nutrient Network, yielded an unprecedented data set and findings that represent a significant advance in ecological thought. "Our study shows no clear relationship between productivity and the number of plant species in small study plots," said Utah State University plant ecologist Peter Adler, the lead author of the study. Adler received his doctorate degree from CSU's Graduate Degree Program in Ecology in 2003.
"We challenged a prevailing model developed in the early 1970s by

British ecologist J. Philip Grime," Adler said. "He proposed that the number of species rises then declines with increasing productivity."

Though hotly debated, this "hump-shaped" model has remained a textbook standard for nearly four decades. However, existing, disparate case studies couldn't conclusively support Grime's unimodal pattern. Inconsistencies in data collection methods further hampered efforts to distill reliable empirical evidence to support the hump-shaped model.

The Nutrient Network, or NutNet, is a cooperative research initiative dedicated to investigating biodiversity and ecosystem processes in grasslands around the world. The initiative provided a unique opportunity to address this question through a coordinated, grassroots, ecological data collection and analyses effort. The network is based at the University of Minnesota, and its coordination is currently funded by the National Science Foundation. Klein, Brown and collaborator Dana Blumenthal from the U.S. Department of Agriculture-Agricultural Research Station (USDA-ARS), along with graduate student Laura Dev, have contributed to the network since 2007, when they established two NutNet study sites. One is located at the Shortgrass Steppe Long Term Ecological Research site near Nunn, Colo., and another is at the USDA-ARS High Plains Grassland Research Station near Cheyenne, Wyo.

"Grasslands are inhabited by approximately 40 percent of the world's population," Klein said. "This study suggests there are other factors aside from productivity that explain patterns of plant diversity across grassland systems globally. Since humans are having such profound effects on climate, resource supply and disturbance regimes, understanding the role these factors play in affecting grassland diversity and its effects on ecosystem processes has critical implications for the well-being of the populations that rely on the essential ecological services that these grasslands provide."

“Studies comparing plant communities across ecosystems can help us understand what causes the patterns we see, and understanding the mechanisms underlying the patterns can help us manage our natural resources more effectively,” Brown said.

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