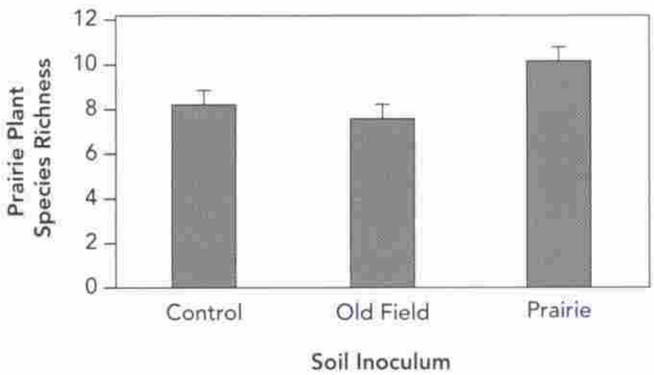

Figure 1. The average diversity of prairie plant species observed in the fourth year after start of restoration, which included inoculation of soil microorganisms.

we found significantly higher diversity of prairie plant species in plots inoculated with prairie soil than in the other two treatments plots ($F^{1,23} = 9.0$, $p < 0.01$, Figure 1). This effect could not be explained by variation in soil minerals between plots.

There are many soil microorganisms that can affect plant dynamics (Bever 2003), so we cannot definitively attribute our results to any one group of organisms. However, because we observed differences in the diversity and composition of the AM fungal community between the inocula, our results are consistent with the possibility that prairie AM fungi may improve the restoration of prairie plant diversity.

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Vole Herbivory Affects Well-Established Forbs in Experimental Tallgrass Planting (Illinois)

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We evaluated how voles (*Microtus pennsylvanicus*) affect survival and growth of established individuals of tallgrass prairie species growing in experimental plantings at the Morton Arboretum in northern Illinois. A previous study showed that herbivory by voles on emerging seedlings had the greatest effect on low-density restoration plantings, including bundleflower (*Desmanthus illinoensis*) and purple coneflower (*Echinacea purpurea*) (Howe and Brown 1999, Howe 2002). We decided to conduct a controlled exclusion experiment to determine how vole herbivory would affect these two species once they are well established as adult plants.

In June 1997, we randomly selected 48 one-year-old plants (24 of each species), and surrounded each with a 3.9-ft (1.2-m) high, 3.2-ft^2 (0.30-m^2) diameter cylinder made of 1-cm mesh (Howe and Brown 1999, Howe 2002). We paired cylinders within each plot for each of the two species, with one cylinder having two 5-cm x 5-cm gates that allowed voles access. We measured plant height in fall 1998 and 1999, and then measured height, harvested, oven-dried to constant mass, and weighed the survivors in October 2000.

Rodent censuses conducted from October 1997 through October 2000 showed that the minimum number of voles per hectare at the site ranged from four in April 1998 to 155 in May 2000 (Turner 2003). We did not find effects of vole herbivory on plants in cylinders in 1998 and 1999, when vole abundances were low during the growing season. However, by October 2000, after a season during which voles increased dramatically, only three bundleflowers and 12 coneflowers were alive in the open cylinders, while 83 percent of individuals of both plant species survived in the closed cylinders.

Although bundelflower individuals in closed cylinders were taller and heavier (182±11 cm and 170±55 g) than in open cylinders (167±15 cm and 157±26), so few survived in the open cylinders that size comparisons are not reliable. Despite significant mortality in cylinders accessible to voles, enough coneflowers survived to show a statistically significant 46 percent loss in height (38±9 cm, open; 83±0 cm, closed) and an apparent, but not statistically significant, 60 percent loss in biomass in open (6±2 g) as compared with closed cylinders (10±3 g).

Voles are more common in fields of forage crops, pastures, or old field successions than in native prairies because pasture legumes and grasses are more palatable than native prairie plants (Lindroth and Batzli 1984). The reduction or elimination of bundleflower, the only common native legume in our synthetic communities, is consistent with the vole-induced reduction of legumes that Sirotnak and Huntly (2000) observed in riparian herbaceous communities in Yellowstone National Park. Elimination of nitrogen-fixing legumes may have potential implications for long-term nitrogen dynamics.

In the larger experiment, purple coneflower is a successful perennial "compensator" that persists as rosettes even in the areas of heaviest browsing (Howe and others 2002). Our experiment revealed that when this species is cut back to a rosette, it is often robust and persists with obvious signs of herbivory. In addition, a rosette mat of low stature offers poor cover for rodents, which then can be expected to reduce foraging activities (Brown 1999). We expect that such an "increaser in numbers" may rebound with declines in vole abundance, but the extent to which it does will depend on the degree to which other species compensate and occupy space over the short- and long-term (Belsky 1987). Decimation of purple coneflower may not alter nitrogen dynamics, but a reduction in the amount of its cover is likely to have a profound effect on further rodent activities.

Vole effects may be accentuated at a restored site if it has high densities of palatable plants that encourage high densities of rodents. To some degree, vole herbivory is unavoidable as vulnerable young plants emerge. Planting less palatable species, such as tough grasses and forbs (like coneflower), in the earliest stages of restoration should result in lower densities of rodents. Managers might further consider taking advantage of foraging theory, which predicts highest use of palatable species with highest availability, by experimenting with planting particularly vulnerable species, such as bundleflower, after dominant unpalatable plants become established, and after rodents have decreased in numbers due to the reduced availability of palatable plants.

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More Native Grasses and Wildflowers on Roadsides. 2003. Anon. **Native Warm-Season Grass Newsletter** 22(1):2-3.

The Missouri Department of Transportation is using federal Interstate Transportation Enhancement Funds to buy native grass and wildflower seeds to plant many newly constructed highway rights-of-way. The Missouri Department of Conservation and Department of Transportation have also developed a plan to convert about 800 acres (320 ha) of roadsides currently covered with tall fescue (*Lolium arundinaceum*), smooth bromegrass (*Bromus inermis*), and weeds to native warm-season grasses and wildflowers. Managers will determine the best method to kill existing vegetation, save desirable native species, and seed native grass and wildflower mixes. They have taken many ideas from the successful program in Iowa (see *ER* 18(3):173-183).

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Soil Invertebrate Fauna Enhances Grassland Succession and Diversity. 2003. De Deyn, G.B., Dept. of Multitrophic Interactions, Centre for Terrestrial Ecology, Netherlands Institute of Ecology (NIOO-KNAW), P.O, Box 40, 6666 ZG, Heteren, The Netherlands, g.dedeyn@nioo.knaw.nl; C.E. Raaljmakers, H.R. Zoomer, M.P. Berg, P.C. de Ruiter, H.A. Verhoef, T.M. Bezemer and W.H. van der Putten. **Nature** 422(6933):711-713.

The authors studied the effect of invertebrate soil fauna communities (including nematodes, micro-arthropods, and beetle larvae) on plant species from early-, mid-, and late-succession grassland communities. They established grassland communities of mixed stands in sterilized soil and then inoculated each unit with soil fauna from one of the three successional stages. The addition of soil fauna from all three stages caused significant shifts in the plant communities toward plant species from the late-succession community. Soil fauna from the mid-succession stage showed the strongest effect. According to the authors, the results indicate a strong link between succession in vegetation and in the soil community composition. They suggest that restorationists consider the role of soil fauna in restoration and conservation projects aimed at plant species diversity.

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Lack of Native Propagules in a Pennsylvania, USA, Limestone Prairie Seed Bank: Futile Hopes for a Role in Ecological Restoration. 2003. Laughlin, D.C., Ecological Restoration Institute, Northern Arizona University, P.O. Box 15017, Flagstaff, AZ 86011, Daniel.Laughlin@nau.edu. **Natural Areas Journal** 23(2):158-164.

Researchers analyzed the soil seed bank of a limestone prairie in Penns Valley, Centre County, Pennsylvania. Soil samples from within the prairie contained viable seeds of 12 native prairie species, but the prairie edge and surrounding forest soils contained only nine and four native prairie species, respectively. Laughlin notes that this means that the richness of prairie propagules in the soil seed bank has declined since woody plants started invading. In addition, the prairie contained no viable seeds of sideoats grama (*Bouteloua curtipendula*), the dominant grass of limestone prairies. Laughlin concludes that restorationists cannot depend on Pennsylvania limestone prairie seed banks to contribute significantly to seedling recruitment during restoration projects.