Species richness, species identity and ecosystem function in managed temperate grasslands

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Introduction Manipulation of plant species diversity may provide a way to improve the ecosystem functioning of managed systems by increasing productivity and suppressing weedy species. As yet, the functional role of species richness is not well-enough understood to enable practical application. We investigated the effects of differing species richness on community stability and invasion resistance in a grazed temperate grassland.

Materials and Methods Nine plant species from three different functional groups (grass, legume, forb) were planted in the autumn of 2001 at University Park, PA, USA, in mixtures of 2, 3, 6 and 9 species, as follows:
2 species: *Dactylis glomerata*, *Trifolium repens:*
3 species: *D. glomerata*, *T. repens*, *Cichorium intybus:*
6 species: *D. glomerata*, *Festuca arundinacea*, *Lolium perenne*, *Trifolium pratense*, *Lotus corniculatus*, *C. intybus:*
9 species: six species mix plus *T. repens*, *Medicago sativa*, *Poa pratensis.*
Two replicates of each treatment were planted in 1 ha plots, and rotationally grazed by dairy cattle during 2002 and 2003. Species composition was assessed during April and October of each year using the multiscale modified Whittaker plot. Percentage canopy cover was visually estimated in 10 quadrats of 1 m^2 for each plot, and species lists were compiled in areas of 10, 100 and 1000 m^2. Canopy cover can sum to more than 100%.

Results Higher richness conferred an establishment advantage; planted species richness was positively correlated with total cover in autumn 2001 and spring 2002 (Fig. 1a). Although cover of unplanted (weedy) species declined with increasing richness on these dates, there was no difference in the number of unplanted species. After the first year there were no significant trends in cover or richness between the treatments (Figure 1). Cover in the 2-species treatment was most affected by drought in the summer of 2002, but all treatments had recovered by autumn 2003, and there was no significant difference in total plant cover thereafter. The higher-species treatments lost planted species over time, even when those species persisted in the lower-species mixtures.

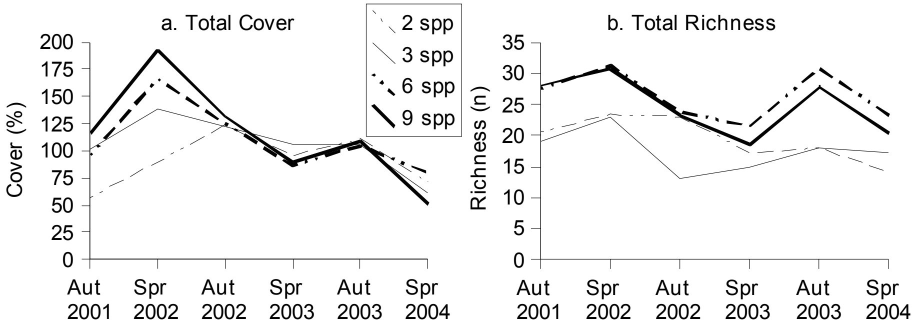

Figure 1 Total plant cover and species richness in grazed pastures of four different initial richness treatments

The forb *C. intybus*, part of the 3, 6 and 9 species mixtures, established rapidly and contributed greatly to the early success of these treatments. Several other grasses and legumes increased in abundance over the first year, then declined. By the end of the study, the same species (*D. glomerata* in all treatments and *T. repens* in 2, 3 and 9-species mixes) were dominant regardless of initial seeding composition. Cover and richness within the 1 m^2 quadrats were only related in the 6- and 9-species mixtures. Richness was significantly correlated between scales for all species treatments.

Conclusions Species identity was more important to cover and invasion resistance than was species richness. Management recommendations based on particular combinations of species may be more effective at improving ecosystem function than those based solely on species richness. If high plant diversity is desired, the management regime must support the maintenance of that diversity or, as in this study, species will tend to disappear from the higher-richness treatments.