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# Quantifying Species Interactions in Experimental Native vs. Exotic Grassland Plant Communities

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**Abstract**
Native ecosystems are currently being replaced by novel, exotic-dominated ecosystems worldwide. Exotic ecosystems differ from native ecosystems in several important ways. For example, exotic ecosystems are often less diverse than native ecosystems, and often contain species without a shared evolutionary history. Previously we found that biodiversity rapidly declined in experimental exotic communities because the mechanisms that maintained diversity in experimental native communities were reduced. Further investigation is needed to explicitly quantify species interactions in native vs. exotic communities. Here we test the hypothesis that exotic species will exhibit more competition, or less facilitation, than ecologically similar native species.

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# Quantifying Species Interactions in Experimental Native vs. Exotic Grassland Plant Communities

**RFR-A9020**

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## Introduction

Native ecosystems are currently being replaced by novel, exotic-dominated ecosystems worldwide. Exotic ecosystems differ from native ecosystems in several important ways. For example, exotic ecosystems are often less diverse than native ecosystems, and often contain species without a shared evolutionary history. Previously we found that biodiversity rapidly declined in experimental exotic communities because the mechanisms that maintained diversity in experimental native communities were reduced. Further investigation is needed to explicitly quantify species interactions in native vs. exotic communities. Here we test the hypothesis that exotic species will exhibit more competition, or less facilitation, than ecologically similar native species.

## Materials and Methods

We conducted a field experiment at Iowa State University's Horticulture Research Station during 2009 to quantify species interactions for seven native and seven exotic perennial herbaceous grassland plant species. Native and exotic species were carefully paired by phylogeny and several ecological characteristics. Species were planted in large pots (1 ft diameter). For each of the 144 pots in the study, we dug a hole, placed a pot in the hole, and filled the pot with the soil from the hole. Species were planted with two methods: by seeding or by transplanting seedlings. Three types of individual interactions were established: isolated individual (i.e., no interactions), monocultures (i.e., intraspecific interactions), and mixtures (i.e., interspecific interactions). Two replicate monocultures and isolated individuals were established for each species with each planting method. Eight replicate mixtures, with all seven native or all seven exotic species, were established for each planting method. Pots were planted with seed during late April, or with seedlings that were grown in a greenhouse during early May. Pots were weeded monthly throughout the growing season and were harvested during early October. At harvest, all plants were clipped 0.5 in. above the soil surface, sorted by species, dried to constant mass, and weighed.

Species interactions were quantified by log-response ratios, which were calculated as the natural logarithm of the ratio of the mass of an individual plant in either monoculture (for intraspecific interactions) or mixture (for interspecific interactions) to the mass of the individual grown with no interactions. A positive or negative log-response ratio indicates facilitation or competition, respectively, with values further from zero indicating stronger interactions. We modeled the effect of our planting (seed or transplant), interaction (intraspecific or interspecific), origin (native or exotic), and species pair (7 species pairs) treatments on the log-response ratio as a fully crossed four-way factorial analysis of variance.

## Results and Discussion

Intraspecific interactions among individuals of native species ranged from facilitation (*Sorghastrum nutans*, *Astragalus canadensis*, *Elymus canadensis*) to competition (*Dalea purpurea*, *Brickellia eupatoroides*) (Figure 1a, b). Similarly, intraspecific interactions among

exotic individuals ranged from facilitation in seeded pots (*Leucanthemum vulgare*) to competition (*Coronilla varia*, *Miscanthus sinensis*) (Figure 1c, d). Only one native species (*Sorghastrum nutans*) exhibited interspecific facilitation in seeded pots (Figure 1a), and no native species exhibited interspecific facilitation in transplanted plots (Figure 1b). No exotic species exhibited interspecific facilitation (Figure 1c, d).

Interactions were generally more competitive in transplanted pots than in seeded pots (Figure 1). Consistent with our hypothesis, exotic species exhibited less facilitation and more competition than native species ($P < 0.01$); however, this was only true for some species pairs ($P < 0.0001$, Figure 1). This suggests that plant-plant interactions will become more antagonistic as native grasslands are replaced by exotic grasslands.

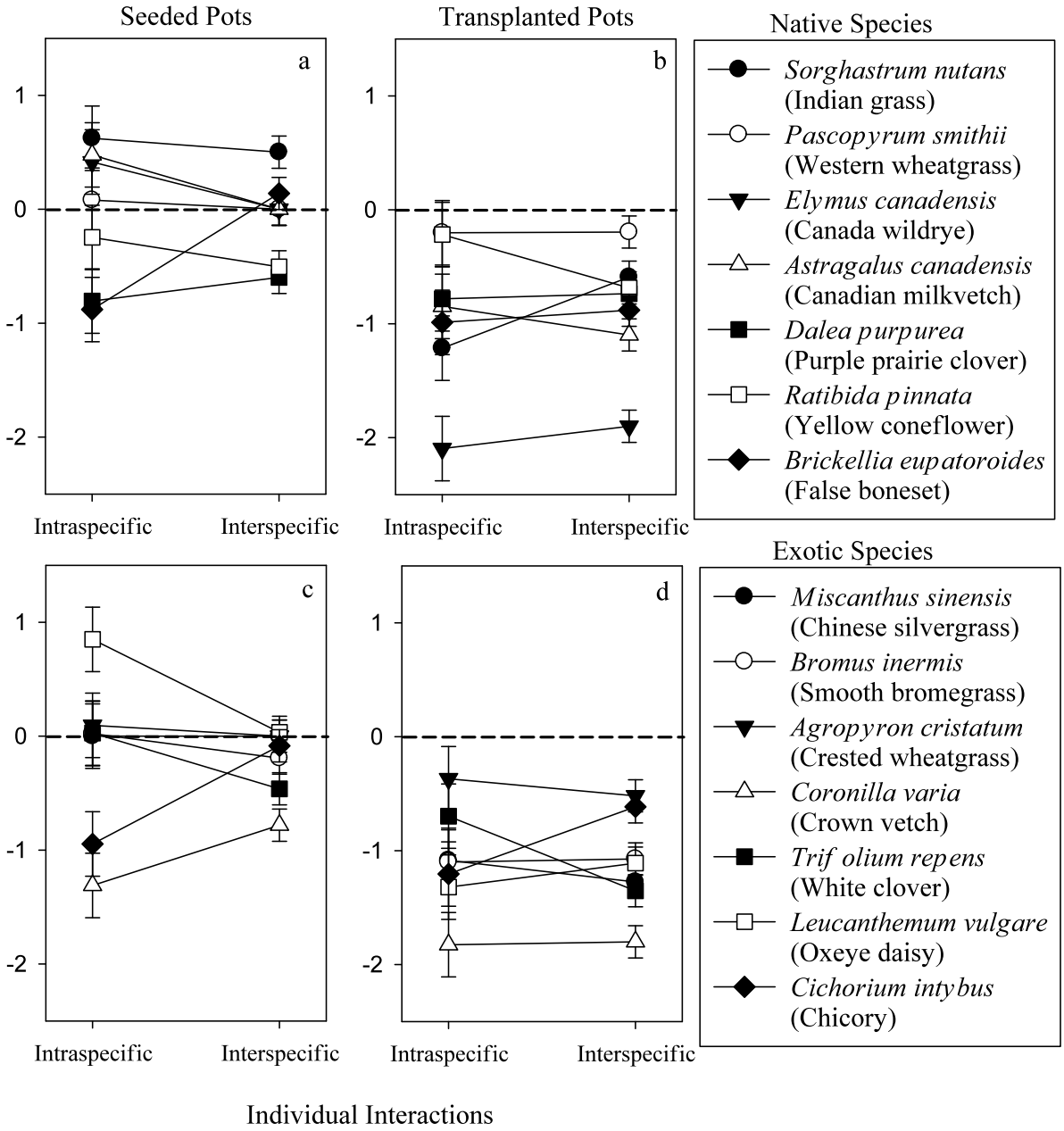


**Figure 1. Intraspecific and interspecific interactions for native (a, b) and exotic (c, d) species planted by seeding (a, c) or transplanting seedlings (b, d) into large pots. Native and exotic species with identical symbols are ecologically similar. Common names are in parentheses. Error bars indicate +/- 1 s.e.m.**