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Adaptive Management Assessment of Prairie Restoration Techniques on Dominant Flora

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Adaptive Management Assessment of Prairie Restoration Techniques on Dominant Flora

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Ecological processes shape the tallgrass prairie of north Texas, through extended periods of drought, wildfire, and grazing. The cycles of disturbance combined with the physiological attributes of the dominant native grasses helped maintain the ecological integrity of the prairie. The suppression of fire and the removal of grazers, combined with a wholesale replacement of native grasses with exotic forage in the early decades of the 20th century, have resulted in the near-total extinction of tallgrass prairie in northern Texas. In the absence of historical disturbances and in the wake of agricultural fields gone fallow, succession has transformed these prairies either into poor quality grasslands or into thorn woodlands or scrublands. To assess the effectiveness of restoration management techniques often employed to restore grasslands, we explored the effects of no maintenance, seeding, mowing, and prescribed burning on the restoration of native Blackland prairie. Seeding is meant to redirect the process of floral succession, burning is meant to mimic natural disturbance, and mowing is meant to be an alternative to burning when burning is not possible.

For our study, we used an old field in the historic prairie areas of LLELA (Figure 1). This site had a history of grazing and cotton production until the late 1940s, but was undisturbed since then until the start of restoration treatments. Mesquite brush was beginning to invade a matrix of exotic grasses, and was cleared in January 1996 using a Bobcat with a 12" tree shear attachment. In February 1996, S. Windhager and D. Barry delineated thirty-seven 40-m by 40-m study plots and two additional 20-m by 40-m control plots (sized to take advantage of space within the study area), which were each subjected to one of six treatments: 1) unseeded and no maintenance (i.e., control, n=9[+2]), 2) unseeded and mowed (n=6), 3) unseeded and burned (n=4), 4) seeded and no maintenance (n=7), 5) seeded and mowed (n=6), and 6) seeded and burned (n=5) (Figure 2; Windhager 1999). In February 1996, the plots were seeded, with a north Texas prairie mix from the Native American Seed Company containing 7 native grasses and 14 native forbs, at a rate of 10 pounds pure live seed/acre using a no-till drill (Table 1). Mowing and burn treatments occurred in February 1998.

We sampled each plot eight times during spring 2002 and again in fall 2002, using randomly placed 50cm x 20cm Daubenmire frames to identify and count grasses and forbs by species. We determined frequencies of occurrence both across treatments and within plots in order to calculate and compare importance values and relative dominance of grasses and forbs according to treatment class. We compared treatments by ranking all species with greater than 10 percent importance values in each treatment, and comparing these lists side by side. We also evaluated species richness across treatments.

We found that the same species of grasses and forbs dominated all treatments (Tables 2-5). Among grasses, the native wiregrass (*Sporobolus asper*), and three exotic species—King Ranch bluestem (*Bothriochloa ischaemum*), Japanese brome (*Bromus japonicus*), and Johnsongrass (*Sorghum halepense*)—were similarly common regardless of treatment. Little bluestem (*Schizachyrium scoparium*) and Indiangrass (*Sogastrum nutans*) were co-dominants in seeded treatments (both were part of the seed mix). We found that the dominant forbs, including

prairie broomweed (*Amphiachyris dracunculoides*), heath aster (*Aster ericoides*), prairie tea (*Croton monanthogynus*), bundleflowers (*Desmanthus* spp.) and goldenrod (*Solidago ulmifolia*), also occurred across all treatments. Maximillian sunflower (*Helianthus maximiliani*), which was part of the seed mix, was a co-dominant forb in the seeded plots. In short, process-based treatments (mowing and burning) had no effect on dominant species composition. Seeding provided a floral input that, six years after planting, enabled co-dominance by native prairie species. However, the restoration treatments did not seem to affect their relative dominance.

We found that grass species richness varied from six species in the unseeded/burned plots (fall sampling) to 12 in the seeded/mowed plots (spring sampling). On average, however, seeded plots (9 ± 1.6) did not have greater overall richness than unseeded plots (8 ± 1.1). Among native grasses, the percent of species richness ranged from 50 percent in unseeded/mowed plots (spring sampling) to 78 percent in both unseeded/no maintenance and seeded/burned plots (fall sampling). Likewise, treatments did not seem to affect forb richness: during spring sampling, we found the greatest number of species in the unseeded/mowed plots (27 species), and during fall sampling in the seeded/no maintenance plots (15 species). Like grasses, forb richness, on average, was the same in both seeded and unseeded plots (17 ± 6.7 and 17 ± 6.5 , respectively). Table 6 summarizes species richness results by sampling period, taxa, and treatment.

Our basic findings are these: if you ignore the seeded species for a moment, you find no real difference in dominance by either grasses or forbs across treatments. Treatments did not change the dominant status of widespread species. The seeding treatments allowed for co-dominance by desirable native grasses, but had little effect on species richness.

We have not evaluated our data for rare species, and we may find significant differences if those species are considered. However, we can only conclude from our analysis to date (given the understanding that it is, after all, a very short time span in ecological time) that seeding can help return native species to restoration sites degraded by past land use practices—which may amount to a managerial “well, *duh*.” We were surprised, however, to find no effect from process-based treatments, especially considering our experiences in other parts of the refuge (for example, finding that low intensity/high residence time backing fires tend to reduce Johnsongrass dominance). We will continue to treat and monitor this site as time goes on.

REFERENCES

Windhager, S. 1999. An assessment of the use of seeding, mowing, and burning in the restoration of an oldfield to tallgrass prairie in Lewisville, Texas. Ph. D. Dissertation, University of North Texas, Denton, Texas.

Figure 1. Location of the Lewisville Research Prairie within LLELA.



Figure 2. Plot layout in the Lewisville Research Prairie (from Windhager 1999).

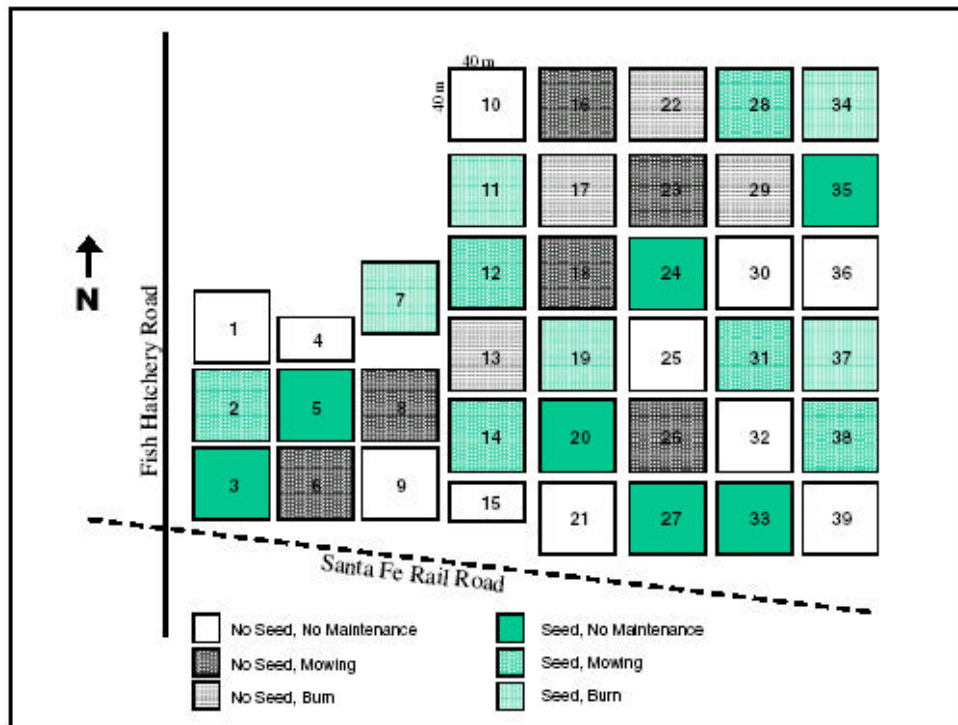


Table 1. Seed mix planted in seeded plots, February 1996 (from Windhager 1999).

Species Name	Common Name	Pounds Pure Live Seed	% of Total Mix
<i>Tripsacum dactyloides</i>	Eastern gammagrass	18	25%
<i>Sogastrum nutans</i>	Indiangrass	12	17%
<i>Schizachyrium scoparium</i>	Little bluestem	10.4	15%
<i>Bouteloua curtipendula</i>	Side-oats grama	10	14%
<i>Panicum virgatum</i>	Switchgrass	10	14%
<i>Leptochloa dubia</i>	Green sprangletop	5	7%
<i>Desmanthus illinoensis</i>	Illinois bundleflower	1.25*	2%
<i>Gaillardia pulchella</i>	Firewheel	1*	1%
<i>Andropogon glomeratus</i>	Bushy bluestem	0.5*	<1%
<i>Chamaecrista fasciculata</i>	Partridge-pea	0.5*	<1%
<i>Coreopsis tinctoria</i>	Plains coreopsis	0.5*	<1%
<i>Dracopis amplexicaulis</i>	Clasping coneflower	0.5*	<1%
<i>Centaurea americana</i>	Basketflower	0.25*	<1%
<i>Echinacea purpurea</i>	Purple coneflower	0.25*	<1%
<i>Engelmannia persistenia</i>	Cutleaf daisy	0.25*	<1%
<i>Helianthus maximiliani</i>	Maximilian sunflower	0.25*	<1%
<i>Monarda citriodora</i>	Horse mint	0.25*	<1%
<i>Rudebeckia hirta</i>	Black-eyed Susan	0.25*	<1%
<i>Asclepias texana</i>	Texas milkweed	0.125*	<1%
<i>Dalea purpurea</i>	Purple prairie clover	0.125*	<1%
<i>Elymus virginicus</i>	Virginia wildrye	0.125*	<1%
<i>Vernonia baldwinii</i>	Western ironweed	0.125*	<1%
	Total	71.65	100%

* Estimated quantity

Table 2. Importance values for grasses, Spring 2002 sampling.

No Seed, No Maintenance		Importance Value
Japanese brome	<i>Bromus japonicus</i>	27%
Wiregrass	<i>Sporobolus asper</i>	25%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	16%
Johnsongrass	<i>Sorghum halapense</i>	12%
No Seed, Mowed		
Johnsongrass	<i>Sorghum halapense</i>	26%
Wiregrass	<i>Sporobolus asper</i>	22%
Japanese brome	<i>Bromus japonicus</i>	16%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	14%
Scribner's panicum	<i>Panicum scribnerianum</i>	12%
No Seed, Burned		
Wiregrass	<i>Sporobolus asper</i>	29%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	15%
Virginia wild rye	<i>Elymus virginicus</i>	11%
Japanese brome	<i>Bromus japonicus</i>	11%
Silver bluestem	<i>Bothriocloa laguroides</i>	11%
Seeded, No Maintenance		
Japanese brome	<i>Bromus japonicus</i>	20%
Wiregrass	<i>Sporobolus asper</i>	20%
Little bluestem	<i>Schizachyrium scoparium</i>	15%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	13%
Indiangrass	<i>Sogastrum nutans</i>	12%
Seeded, Mowed		
Little bluestem	<i>Schizachyrium scoparium</i>	18%
Wiregrass	<i>Sporobolus asper</i>	17%
Johnsongrass	<i>Sorghum halapense</i>	14%
Japanese brome	<i>Bromus japonicus</i>	13%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	10%
Seeded, Burned		
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	27%
Johnsongrass	<i>Sorghum halapense</i>	21%
Japanese brome	<i>Bromus japonicus</i>	14%
Wiregrass	<i>Sporobolus asper</i>	13%
Little bluestem	<i>Schizachyrium scoparium</i>	10%

Table 3. Importance values for grasses, Fall 2002 sampling.

No Seed, No Maintenance		Importance Value
Wiregrass	<i>Sporobolus asper</i>	29%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	26%
Johnsongrass	<i>Sorghum halapense</i>	16%
Silver bluestem	<i>Bothriocloa laguroides</i>	10%
No Seed, Mowed		
Wiregrass	<i>Sporobolus asper</i>	36%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	16%
Silver bluestem	<i>Bothriocloa laguroides</i>	15%
Johnsongrass	<i>Sorghum halapense</i>	14%
No Seed, Burned		
Wiregrass	<i>Sporobolus asper</i>	32%
Johnsongrass	<i>Sorghum halapense</i>	26%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	16%
Silver bluestem	<i>Bothriocloa laguroides</i>	16%
Seeded, No Maintenance		
Wiregrass	<i>Sporobolus asper</i>	21%
Indiangrass	<i>Sogastrum nutans</i>	20%
Little bluestem	<i>Schizachyrium scoparium</i>	19%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	14%
Johnsongrass	<i>Sorghum halapense</i>	10%
Seeded, Mowed		
Little bluestem	<i>Schizachyrium scoparium</i>	24%
Indiangrass	<i>Sogastrum nutans</i>	21%
Wiregrass	<i>Sporobolus asper</i>	17%
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	12%
Seeded, Burned		
King Ranch bluestem	<i>Bothriocloa ischaemum</i>	23%
Little bluestem	<i>Schizachyrium scoparium</i>	18%
Wiregrass	<i>Sporobolus asper</i>	17%
Indiangrass	<i>Sogastrum nutans</i>	16%
Johnsongrass	<i>Sorghum halapense</i>	12%

Table 4. Importance values for forbs, Spring 2002 sampling.

No Seed, No Maintenance		Importance Value
Prairie tea	<i>Croton monanthogynus</i>	14%
Broomweed	<i>Amphiachyris dracunculoides</i>	14%
Bundleflower	<i>Desmanthus</i> spp.	14%
No Seed, Mowed		
Bundleflower	<i>Desmanthus</i> spp.	12%
Heath aster	<i>Aster ericoides</i>	11%
Prairie tea	<i>Croton monanthogynus</i>	11%
Broomweed	<i>Amphiachyris dracunculoides</i>	10%
No Seed, Burned		
Bundleflower	<i>Desmanthus</i> spp.	10%
Prairie tea	<i>Croton monanthogynus</i>	10%
Seeded, No Maintenance		
Prairie tea	<i>Croton monanthogynus</i>	13%
Broomweed	<i>Amphiachyris dracunculoides</i>	12%
Maximillian sunflower	<i>Helianthus maximiliani</i>	12%
Bundleflower	<i>Desmanthus</i> spp.	10%
Seeded, Mowed		
Prairie tea	<i>Croton monanthogynus</i>	12%
Bundleflower	<i>Desmanthus</i> spp.	11%
Maximillian sunflower	<i>Helianthus maximiliani</i>	10%
Seeded, Burned		
Bundleflower	<i>Desmanthus</i> spp.	14%
Maximillian sunflower	<i>Helianthus maximiliani</i>	12%

Table 5. Importance values for forbs, Fall 2002 sampling.

No Seed, No Maintenance		Importance Value
Prairie tea	<i>Croton monanthogynus</i>	23%
Goldenrod	<i>Solidago ulmifolia</i>	21%
Broomweed	<i>Amphiachyris dracunculoides</i>	20%
No Seed, Mowed		
Prairie tea	<i>Croton monanthogynus</i>	22%
Heath aster	<i>Aster ericoides</i>	17%
Snow-on-the-prairie	<i>Euphorbia bicolor</i>	14%
Broomweed	<i>Amphiachyris dracunculoides</i>	10%
No Seed, Burned		
Prairie tea	<i>Croton monanthogynus</i>	27%
Heath aster	<i>Aster ericoides</i>	14%
Broomweed	<i>Amphiachyris dracunculoides</i>	13%
Snow-on-the-prairie	<i>Euphorbia bicolor</i>	12%
Bundleflower	<i>Desmanthus</i> spp	11%
Seeded, No Maintenance		
Prairie tea	<i>Croton monanthogynus</i>	24%
Broomweed	<i>Amphiachyris dracunculoides</i>	19%
Maximillian sunflower	<i>Helianthus maximiliani</i>	16%
Goldenrod	<i>Solidago ulmifolia</i>	14%
Seeded, Mowed		
Maximillian sunflower	<i>Helianthus maximiliani</i>	24%
Prairie tea	<i>Croton monanthogynus</i>	21%
Broomweed	<i>Amphiachyris dracunculoides</i>	14%
Snow-on-the-prairie	<i>Euphorbia bicolor</i>	12%
Heath aster	<i>Aster ericoides</i>	10%
Goldenrod	<i>Solidago ulmifolia</i>	10%
Seeded, Burned		
Maximillian sunflower	<i>Helianthus maximiliani</i>	25%
Goldenrod	<i>Solidago ulmifolia</i>	22%
Broomweed	<i>Amphiachyris dracunculoides</i>	16%
Prairie tea	<i>Croton monanthogynus</i>	15%

Table 6. Species richness data by treatment for all species/sampling periods.

Spring Grasses			
<i>Treatment</i>	<i>Species Richness</i>	<i>Natives</i>	<i>% Natives</i>
No Seed, No Maintenance	8	5	63%
No Seed, Mowed	8	4	50%
No Seed, Burned	8	5	63%
Seeded, No Maintenance	10	7	70%
Seeded, Mowed	12	9	75%
Seeded, Burned	9	6	67%
Fall Grasses			
<i>Treatment</i>	<i>Species Richness</i>	<i>Natives</i>	<i>% Natives</i>
No Seed, No Maintenance	9	7	78%
No Seed, Mowed	7	5	71%
No Seed, Burned	6	4	67%
Seeded, No Maintenance	8	6	75%
Seeded, Mowed	8	6	75%
Seeded, Burned	9	7	78%
Spring Forbs			
<i>Treatment</i>	<i>Species Richness</i>	<i>Seeded*</i>	<i>% Seeded</i>
No Seed, No Maintenance	17	5	29%
No Seed, Mowed	27	6	22%
No Seed, Burned	22	4	18%
Seeded, No Maintenance	22	8	36%
Seeded, Mowed	21	10	48%
Seeded, Burned	24	6	25%
Fall Forbs			
<i>Treatment</i>	<i>Species Richness</i>	<i>Seeded*</i>	<i>% Seeded</i>
No Seed, No Maintenance	14	2	14%
No Seed, Mowed	14	1	7%
No Seed, Burned	10	1	10%
Seeded, No Maintenance	15	2	13%
Seeded, Mowed	10	1	10%
Seeded, Burned	9	1	11%

* Refers to species that were in seed mix (Table 1); they were not seeded into “no seed” plots but occurred there anyway in 2002 sampling