

“Seasonal Shifts in Diversity and Composition of a Tallgrass Prairie Restoration Have Implications for Sampling Time”

Naomi Betson and Bryan Latimer Foster

Ecological Restoration v. 41 n. 1

Table S1. All forb and grass species sown at Free State Prairie, their common names, families, life history (annual or perennial), photosynthetic pathways (C3 or C4), and whether or not they were found at the site in 2019 (Presence). All sown species are native. * indicates species found in plots but not in 1-m² subplots.

Genus and Species	Common Name	Family	Life History	Photo Path	Presence
<i>Andropogon gerardii</i>	Big bluestem	Poaceae	Perennial	C4	Yes
<i>Bouteloua curtipendula</i>	Sideoats grama	Poaceae	Perennial	C4	Yes
<i>Bouteloua dactyloides</i>	Buffalograss	Poaceae	Perennial	C4	No
<i>Bouteloua gracilis</i>	Blue grama	Poaceae	Perennial	C4	Yes
<i>Elymus canadensis</i>	Canadian wildrye	Poaceae	Perennial	C3	No
<i>Panicum virgatum</i>	Switchgrass	Poaceae	Perennial	C4	Yes
<i>Schizachyrium scoparium</i>	Little bluestem	Poaceae	Perennial	C4	Yes
<i>Sorghastrum nutans</i>	Indian grass	Poaceae	Perennial	C4	Yes
<i>Sporobolus heterolepis</i>	Prairie dropseed	Poaceae	Perennial	C4	Yes
<i>Tripsacum dactyloides</i>	Eastern gammagrass	Poaceae	Perennial	C4	Yes
<i>Amorpha canescens</i>	Lead plant	Fabaceae	Perennial	C3	No
<i>Asclepias tuberosa</i>	Butterfly weed	Apocynaceae	Perennial	C3	No
<i>Baptisia australis</i>	Blue wild indigo	Fabaceae	Perennial	C3	Yes*
<i>Baptisia alba</i>	White wild indigo	Fabaceae	Perennial	C3	Yes*
<i>Chaemacrista fasciculata</i>	Showy partridge pea	Fabaceae	Annual	C3	Yes
<i>Coreopsis tinctoria</i>	Plains coreopsis	Asteraceae	Annual	C3	Yes
<i>Dalea purpurea</i>	Purple prairie clover	Fabaceae	Perennial	C3	No
<i>Desmanthus illinoensis</i>	Illinois bundleflower	Fabaceae	Perennial	C3	Yes
<i>Echinacea atrorubens</i>	Topeka purple coneflower	Asteraceae	Perennial	C3	Yes
<i>Eryngium yuccifolium</i>	Rattlesnake master	Apiaceae	Perennial	C3	Yes
<i>Helianthus grosseserratus</i>	Sawtooth sunflower	Asteraceae	Perennial	C3	Yes
<i>Helianthus mollis</i>	Ashy sunflower	Asteraceae	Perennial	C3	Yes
<i>Lespedeza capitata</i>	Round-head bush clover	Fabaceae	Perennial	C3	No
<i>Liatris aspera</i>	Button gayfeather	Asteraceae	Perennial	C3	No
<i>Liatris pycnostachya</i>	Thick-spike gayfeather	Asteraceae	Perennial	C3	Yes
<i>Monarda citriodora</i>	Lemon bee balm	Lamiaceae	Perennial	C3	Yes*
<i>Monarda fistulosa</i>	Wild bergamot	Lamiaceae	Perennial	C3	Yes
<i>Oligoneuron rigidum</i>	Stiff goldenrod	Asteraceae	Perennial	C3	Yes
<i>Penstemon digitalis</i>	Smooth beardtongue	Plantaginaceae	Perennial	C3	Yes
<i>Pycnanthemum tenuifolium</i>	Slender mountain mint	Lamiaceae	Perennial	C3	Yes
<i>Ratibida columnifera</i>	Upright prairie coneflower	Asteraceae	Perennial	C3	Yes
<i>Ratibida pinnata</i>	Grey-head prairie coneflower	Asteraceae	Perennial	C3	Yes
<i>Rudbeckia hirta</i>	Black-eyed Susan	Asteraceae	Perennial	C3	Yes
<i>Salvia azurea</i>	Blue sage	Laminaceae	Perennial	C3	Yes
<i>Senna marilandica</i>	Wild senna	Fabaceae	Perennial	C3	Yes

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Ecological Restoration v. 41 n. 1

<i>Silphium integrifolium</i>	Whole-leaf rosinweed	Asteraceae	Perennial	C3	Yes
<i>Silphium laciniatum</i>	Compass plant	Asteraceae	Perennial	C3	Yes
<i>Symphyotrichum novae-angliae</i>	New England aster	Asteraceae	Perennial	C3	Yes
<i>Symphyotrichum oolentangiense</i>	Azure aster	Asteraceae	Perennial	C3	No
<i>Tradescantia ohiensis</i>	Ohio spiderwort	Commelinaceae	Perennial	C3	Yes
<i>Vernonia baldwinii</i>	Western ironweed	Asteraceae	Perennial	C3	Yes

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Naomi Betson and Bryan Latimer Foster

Ecological Restoration v. 41 n. 1

Table S2. The 15 species that contribute the most to the compositional differences between early and late-season surveys based on presence-absence SIMPER analysis, their common names, functional groups (based on sowing and growth form), origin (native or nonnative), percent contributions to the compositional differences between seasons (% Cont.), and which season they are most abundant (Season).

Genus and Species	Common Name	Functional Group	Origin	% Cont.	Season
<i>Galium pedemontanum</i>	Foothill Bedstraw	Nonsown forb	Nonnative	5.20	Late
<i>Lactuca</i>	Wild lettuce	Nonsown forb	Nonnative	5.20	Late
<i>Bromus tectorum</i>	Cheatgrass	Nonsown graminoid	Nonnative	5.03	Early
<i>Bouteloua curtipendula</i>	Sideoats grama	Sown grass	Native	4.90	Early
<i>Liatris pycnostachya</i>	Thick-spike gayfeather	Sown forb	Native	4.09	Late
<i>Conyza canadensis</i>	Horseweed	Nonsown forb	Native	5.20	Early
<i>Coreopsis tinctoria</i>	Plains coreopsis	Sown forb	Native	3.59	Late
<i>Helianthus mollis</i>	Ashy sunflower	Sown forb	Native	3.57	Early
<i>Ipomoea</i>	Morning glory	Nonsown forb	Nonnative	5.20	Late
<i>Panicum virgatum</i>	Switchgrass	Nonsown graminoid	Native	3.15	Late
<i>Carex</i>	Sedges	Nonsown graminoid	Native	2.68	Early
<i>Solanum carolinense</i>	Carolina horsenettle	Nonsown forb	Native	5.20	Late
<i>Ambrosia artemisiifolia</i>	Common ragweed	Nonsown forb	Native	5.20	Early
<i>Oligoneuron rigidum</i>	Stiff goldenrod	Sown forb	Native	2.55	Late
<i>Symphotrichum novae-angliae</i>	New England aster	Sown forb	Native	2.35	Late

“Seasonal Shifts in Diversity and Composition of a Tallgrass Prairie Restoration Have Implications for Sampling Time”

Naomi Betson and Bryan Latimer Foster

Ecological Restoration v. 41 n. 1

Table S3. Degrees of freedom (between-group and within-group), F statistics, and *p*-values for ANOVAs comparing the cover of sown forbs, sown grasses, nonsown species, native nonsown species, and nonnative species; richness, evenness, and diversity of all species; and the richness of sown forbs, sown grasses, nonsown species, native nonsown species, and nonnative species between seasons, treatments, and their interactions.

		df	F	<i>p</i>
Sown forb cover	Season	2, 20	27.974	0.000 ***
	Treatment	1, 5	9.885	0.026 *
	Interaction	2, 20	2.838	0.082
Sown grass cover	Season	2, 20	31.195	0.000 ***
	Treatment	1, 5	0.642	0.459
	Interaction	2, 20	3.082	0.068
Nonsown cover	Season	2, 20	18.589	0.000 ***
	Treatment	1, 10	1.987	0.189
	Interaction	2, 20	0.947	0.405
Native nonsown cover	Season	2, 20	17.517	0.000 ***
	Treatment	1, 5	7.447	0.041 *
	Interaction	2, 20	1.295	0.296
Nonnative cover	Season	2, 20	11.161	< 0.001 ***
	Treatment	1, 5	0.135	0.728
	Interaction	2, 20	1.180	0.328
Richness	Season	2, 20	64.276	0.000 ***
	Treatment	1, 5	2.857	0.152
	Interaction	2, 20	0.362	0.701
Evenness	Season	2, 25	1.866	0.176
	Treatment	1, 25	12.179	0.002 **
	Interaction	2, 25	1.297	0.291
Diversity	Season	2, 20	25.409	0.000 ***
	Treatment	1, 10	4.583	0.058
	Interaction	2, 20	5.070	0.017*
Sown forb richness	Season	2, 20	13.109	0.000 ***
	Treatment	1, 5	0.413	0.549
	Interaction	2, 20	0.084	0.920
Sown grass richness	Season	2, 20	5.000	0.017 *
	Treatment	1, 10	0.088	0.773
	Interaction	2, 20	0.000	1.000

“Seasonal Shifts in Diversity and Composition of a Tallgrass Prairie Restoration Have Implications for Sampling Time”

Naomi Betson and Bryan Latimer Foster

Ecological Restoration v. 41 n. 1

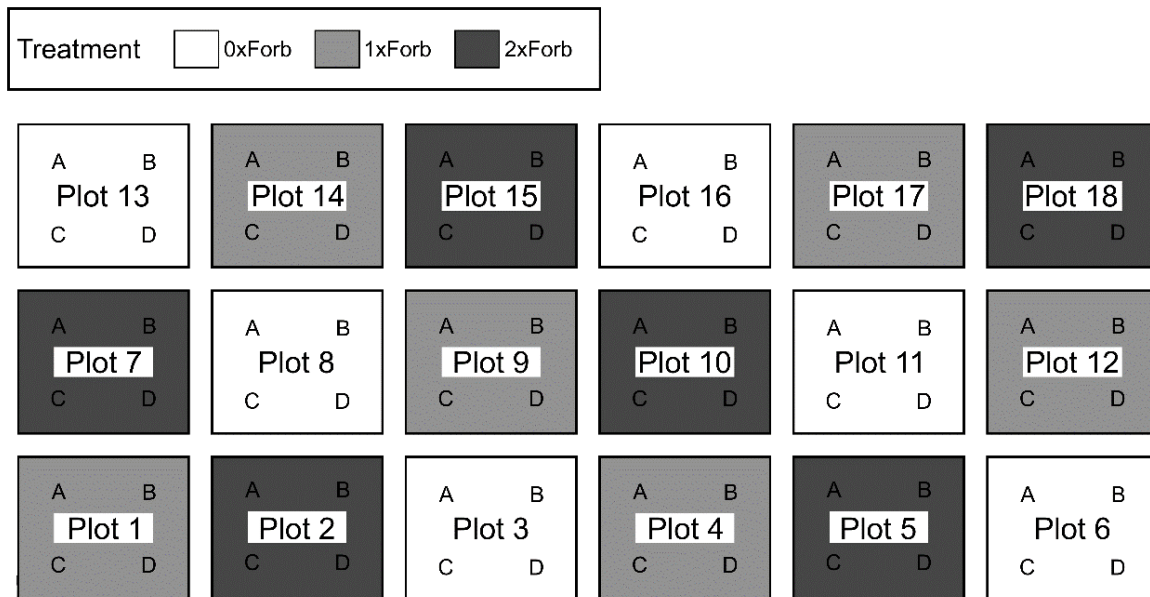
Nonsown richness	Season	2, 20	67.818	0.000 ***
	Treatment	1, 5	8.673	0.032 *
	Interaction	2, 20	0.395	0.679
Native nonsown richness	Season	2, 20	22.669	0.000 ***
	Treatment	1, 10	0.691	0.425
	Interaction	2, 20	1.165	0.332
Nonnative richness	Season	2, 20	48.925	0.000 ***
	Treatment	1, 5	4.167	0.097
	Interaction	2, 20	1.755	0.199

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Ecological Restoration v. 41 n. 1

Figure S1. Experimental design of Free State Prairie in Lawrence, KS, USA showing plots, subplots (A, B, C, and D), and forb seeding density treatments. Only 1xForb and 2xForb treatments were included in analyses in this study.



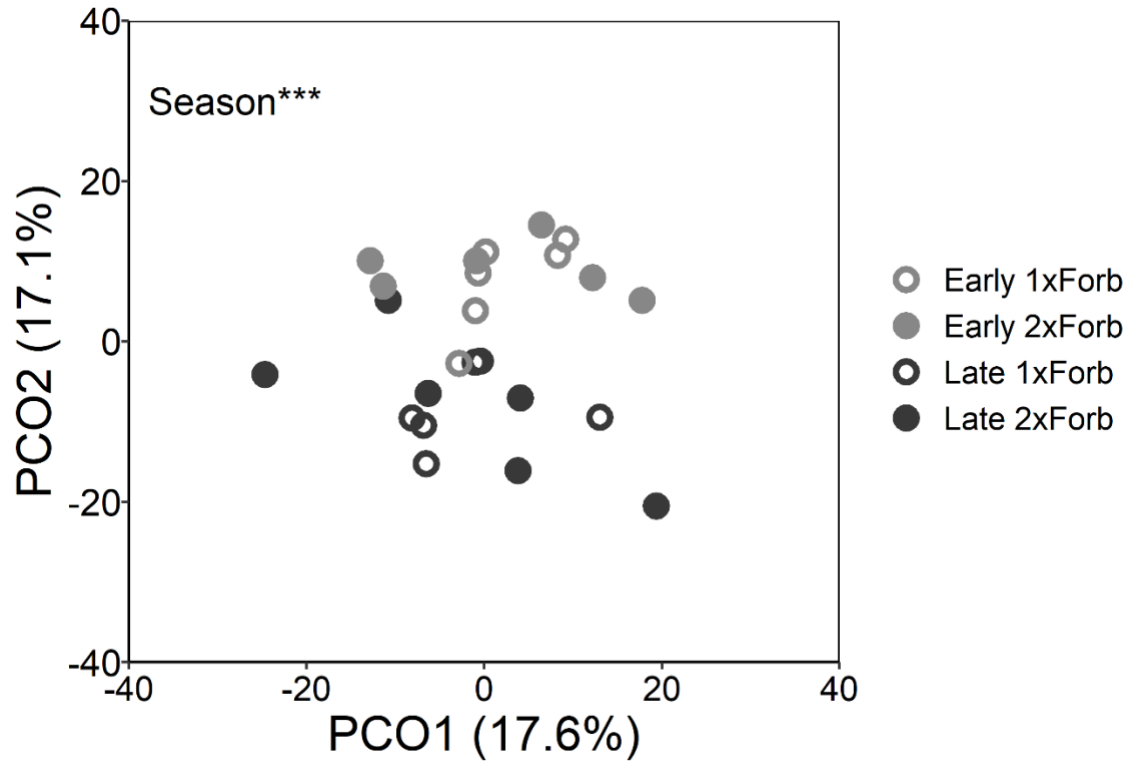
“Seasonal Shifts in Diversity and Composition of a Tallgrass Prairie Restoration Have Implications for Sampling Time”

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Ecological Restoration v. 41 n. 1

Figure S2. Sorensen principle coordinates analysis. Colors indicate season, shapes indicate

treatment. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

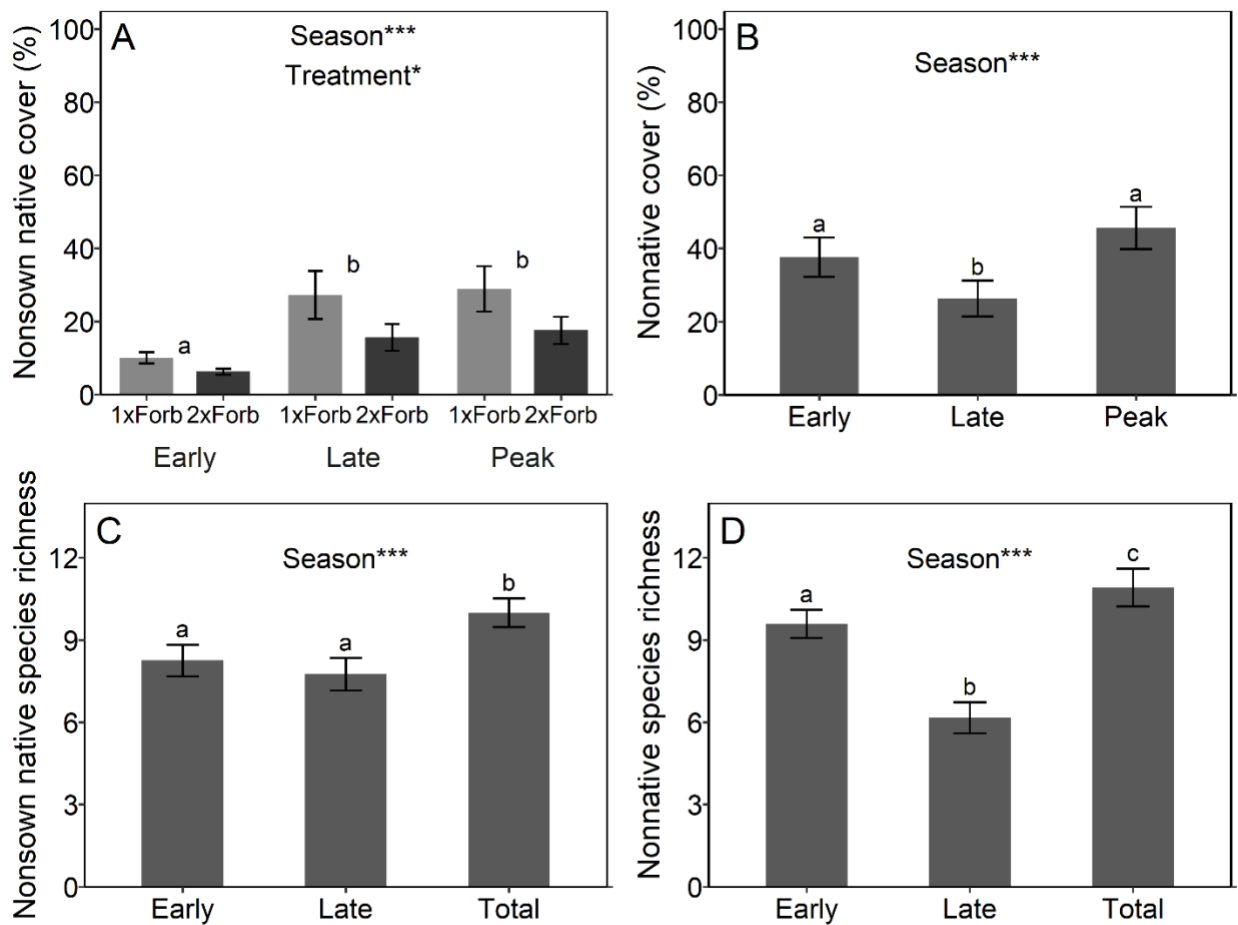


“Seasonal Shifts in Diversity and Composition of a Tallgrass Prairie Restoration Have Implications for Sampling Time”

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Ecological Restoration v. 41 n. 1

Figure S3. Percent cover (mean \pm 1 SE) of A) native and B) non-native nonsown species, and species richness (mean \pm 1 SE) of C) native and D) non-native nonsown species. Because site management involves removal of select invasives, nonnative responses should be interpreted with caution. Seasons that are significantly different ($p < 0.05$) are indicated with different letters. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



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Ecological Restoration v. 41 n. 1

Figure S4. Peak cover (mean \pm 1 SE) of the 12 most abundant sown species in the 1xForb and 2xForb treatments. Refer to Table S1 for species details.

