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IRVINE PRAIRIE

Winter Meeting | March 05, 2022

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Tallgrass Prairie
CENTER
University of Northern Iowa

Science Update

2022

2022 Irvine Prairie Science Update

Year 4 (2021)

Prepared by Justin Meissen[1], Tallgrass Prairie Center, University of Northern Iowa

Introduction

We continued the restoration and maintenance of an ecologically diverse tallgrass prairie at Irvine Prairie in 2021, seeding ~ 14 ac on the back slopes and drainageways of the east-central quarter of the site. In order to ensure that our efforts at restoring a diverse prairie are effective, we monitor our progress through detailed vegetation sampling. Monitoring also allows us to anticipate potential problems in the future, and helps us tweak our management practices in order to get the best results we can get out of the seeds and plants we've planted. This document serves as a "check-up" to see how the restoration is doing, and how well we are meeting our goals. In this update we 1) review how we conducted our monitoring (Methods), 2) show what the monitoring tells us (Results), and 3) discuss steps we should take based on our results (Management Implications).

Methods

Our approach to monitoring is to use randomly placed, permanent plots to answer our questions about the performance and ecology of Irvine Prairie. We added 14 new monitoring points in 2021. Each permanent plot consists of two steel pipes recessed into the ground at the corners (southwest and northeast) of a 1 m^2 square area, with approximately 50.8 mm of exposed pipe. A custom constructed sampling frame with downward facing pipefittings can be placed on the permanently established pipes to form a repeatable sampling area. These permanent steel "corner posts" are designed to withstand both fire and mowing (> 11.4 cm), and similar permanent marker designs have been used successfully under comparable circumstances (Meissen et al. 2017). The configuration of the plot markers established in 2021 differs from seed mix areas planted in 2018-2019, which have pipes at the northwest and southeast corners of the plot.

We measured species identity, vegetation density and canopy cover metrics at each sampling location in September 2021. To measure canopy cover, we identified all species present and estimated the area covering the quadrat by each species (including bare ground) using Daubenmire cover classes.

We then used the class midpoints to estimate canopy cover by species and combined species data to estimate canopy cover by functional groups.

We used this data (species presence in 1 m^2) to estimate species richness. We measured density data using a smaller 0.125 m^2 quadrat nested in the southwest corner of the larger 1 m^2 quadrat in areas seeded this year. Here we measured genet (individual plants) density for all species present in the quadrat.

To measure plant composition at Irvine Prairie more generally, we conducted meandering walks through each seed mix area. During the walk, we recorded all planted species encountered, and estimated their overall abundance using a qualitative scale: Abundant, Frequent, Occasional, Sparse. See (McColpin et al. 2019) for a detailed description of the method used for meandering walk surveys.

We also implemented nested frequency monitoring in seed mix areas that were four years old (2018 planting area). Results generally reflect outcomes from cover monitoring and are not reported here.

Figure 1: Typical view in July 2020 of the central mid-slopes (seeded April 2020). Nurse crop well

Results

2021 Planting Area (first growing season)

Overall, initial restoration outcomes were quite successful. Despite a significant drought event, nurse crops and native species established at relatively high rates across the site (Fig. 1). Weed issues, primarily due to prickly lettuce (Lactuca serriola), were localized but significant in areas near the waterway. Limited precipitation during the growing season prevented any erosion issues.

Planted seed mixes generally established very well (Fig. 2). Compared to other benchmark seed mixes, the seed mixes planted on the back slope areas performed similarly to the Nashua Diversity Mix, which we consider excellent for prairie reconstructions. The seed mix planted on the low areas that run through the main drainage area of Irvine Prairie had fair establishment, though native plant density after
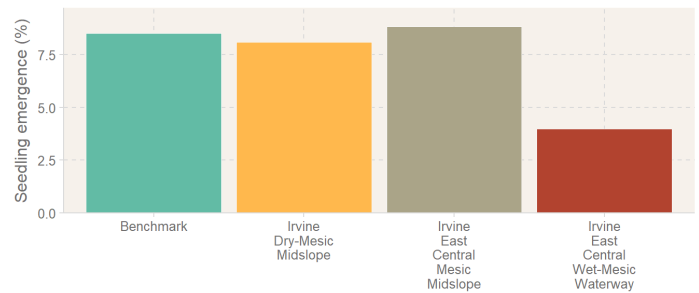

Figure 2: Seedling emergence (percent of sown seeds observed as seedlings after one growing season) in 2021 seeding areas
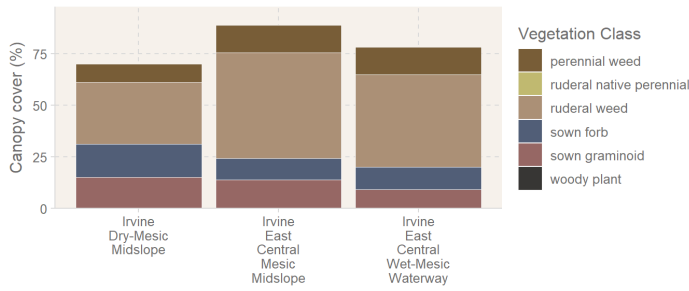
Figure 3: Canopy cover (2021) by vegetation class in 2021 planting areas. Cover may exceed 100% due to cover class use.
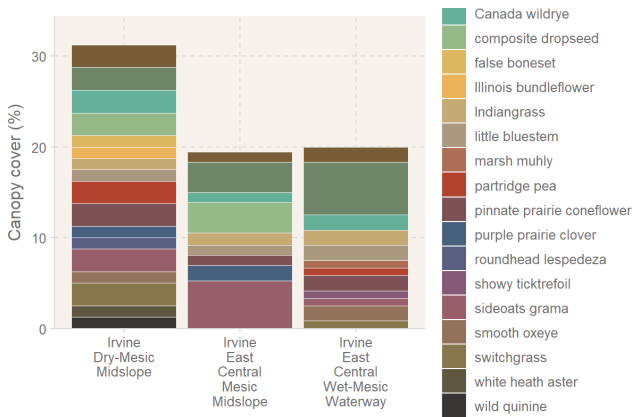

Figure 4: Canopy cover (2021) of top 10 sown species in 2021 planting areas, including ties. Cover may exceed 100 percent due to cover class use.

one growing season was nearly 3 plants per square foot, which is well over the rule-of-thumb minimum for successful prairie reconstruction (one plant per square foot) (Smith et al. 2010). Vegetation structure was mostly dominated by annual weeds and bare ground in the 2021 planting areas (Fig. 3). High annual weed cover in the first year is typical of most prairie reconstructions, and resembles estimates of first year vegetation found in other places at Irvine Prairie. All areas seeded in 2021 had a relatively even mix of native forbs, annual/biennial weeds, native grass, and perennial weeds.

We found nearly 40 species throughout the planting site (Table 1), which is similar to other first year plantings at Irvine Prairie.

We found nearly all planted species at low abundance (1-5% cover) but there was high variability in abundance among species (Fig. 4). The most common species were black-eyed Susan, side oats grama, and composite dropseed which were found around 5% cover.

Table 1: Species and abundance found in the 2019 seeding areas (first growing season).

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	Andropogon gerardii	Very Common	stiff sunflower	Helianthus pauciflorus ssp. pauciflorus	Occasional
white sagebrush	Artemisia ludoviciana	Frequent	smooth oxeye	Heliopsis helianthoides	Very Common
swamp milkweed	Asclepias incarnata	Sparse	roundhead lespedeza	Lespedeza capitata	Occasional
common milkweed	Asclepias syriaca	Sparse	wild bergamot	Monarda fistulosa	Sparse
butterfly milkweed	Asclepias tuberosa	Sparse	marsh muhly	Muhlenbergia racemosa	Sparse
whorled milkweed	Asclepias verticillata	Occasional	switchgrass	Panicum virgatum	Occasional
Canadian milkvetch	Astragalus canadensis	Occasional	wild quinine	Parthenium integrifolium	Sparse
sideoats grama	Bouteloua curtipendula	Frequent	pinnate prairie coneflower	Ratibida pinnata	Very Common
false boneset	Brickellia eupatorioides	Frequent	blackeyed Susan	Rudbeckia hirta	Very Common
partridge pea	Chamaecrista fasciculata	Frequent	little bluestem	Schizachyrium scoparium	Very Common
stiff tickseed	Coreopsis palmata	Sparse	wholeleaf rosinweed	Silphium integrifolium	Sparse

tall tickseed	*Coreopsis tripteris*	Sparse	stiff goldenrod	*Solidago rigida*	Sparse
white prairie clover	*Dalea candida*	Sparse	Indiangrass	*Sorghastrum nutans*	Frequent
purple prairie clover	*Dalea purpurea*	Frequent	composite dropseed	*Sporobolus compositus*	Very Common
Illinois ticktrefoil	*Desmodium illinoense*	Occasional	white heath aster	*Symphyotrichum ericoides*	Sparse
tall cinquefoil	*Drymocallis arguta*	Sparse	New England aster	*Symphyotrichum novae-angliae*	Occasional
pale purple coneflower	*Echinacea pallida*	Sparse	hoary verbena	*Verbena stricta*	Sparse
Canada wildrye	*Elymus canadensis*	Frequent	prairie ironweed	*Vernonia fasciculata*	Sparse
Virginia wildrye	*Elymus virginicus*	Sparse			
sawtooth sunflower	*Helianthus grosseserratus*	Sparse			

2020 Planting Area (second growing season)

Figure 5: Typical view in July 2021 of the west lowlands looking toward west midslopes (seeded May 2020). Pinnate prairie coneflower dominates the area, with blackeyed Susan, Canada wildrye, and smooth oxeye flowering.

Progress toward a diverse tallgrass prairie continued on central areas of Irvine Prairie planted in 2020.

In this area's second year, we observed the expected trends in species composition (early successional species dominance) and generally high native cover (Fig. 5). Weed abundance was reduced from the prior year, but both perennial and annual weeds remained a significant portion of vegetation in the second year. Compared to the previous year, we found relatively higher cover of native grasses (Fig. 6).

We found 57 species throughout the planting site, 9 more than we found the previous year (Table 2). Species abundance was highly variable, but we found most at low abundance (1-5% cover) (Fig. 7). Both Virginia and Canada wild rye, perennial cool season grasses, were important species across the 2020 planting sites. Virginia wild rye was especially common in the low areas adjacent to the waterway. Other species including smooth oxeye and switchgrass were also common in these areas.
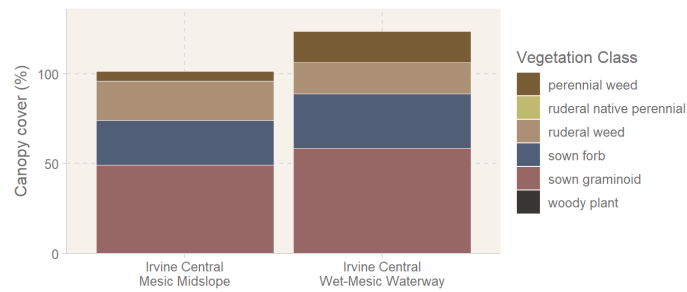
The 2-acre area broadcast seeded in fall 2020 was again characterized by slow establishment of native species. The area vegetation was still dominated by annual weeds, though native plants continued to emerge at very low density throughout the broadcast seeding area. Sky blue aster, white wild indigo, and rattlesnake master were some of the plants we found scattered throughout this area.
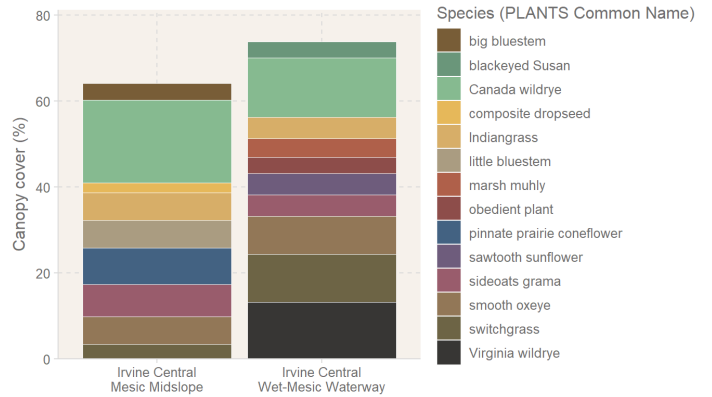

Figure 7: Canopy cover (2021) of top 10 sown species in 2020 planting areas, including ties. Cover may exceed 100% due to cover class use.

Figure 6: Canopy cover (2021) by vegetation class in 2020 planting areas. Cover may exceed 100% due to cover class use.

Table 2: Species and abundance found in the 2019 seeding areas (second growing season).

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
wbig bluestem	*Andropogon gerardii*	Frequent	great blue lobelia	*Lobelia siphilitica*	Sparse
white sagebrush	*Artemisia ludoviciana*	Occasional	American water horehound	*Lycopus americanus*	Sparse
swamp milkweed	*Asclepias incarnata*	Sparse	wild bergamot	*Monarda fistulosa*	Frequent
common milkweed	*Asclepias syriaca*	Sparse	marsh muhly	*Muhlenbergia racemosa*	Frequent
butterfly milkweed	*Asclepias tuberosa*	Occasional	switchgrass	*Panicum virgatum*	Frequent
whorled milkweed	*Asclepias verticillata*	Sparse	wild quinine	*Parthenium integrifolium*	Frequent
Canadian milkvetch	*Astragalus canadensis*	Frequent	foxglove beardtongue	*Penstemon digitalis*	Sparse
sideoats grama	*Bouteloua curtipendula*	Very Common	obedient plant	*Physostegia virginiana*	Sparse
false boneset	*Brickellia eupatorioides*	Occasional	whorled mountainmint	*Pycnanthemum pilosum*	Sparse
partridge pea	*Chamaecrista fasciculata*	Sparse	pinnate prairie coneflower	*Ratibida pinnata*	Very Common
tall tickseed	*Coreopsis tripteris*	Occasional	blackeyed Susan	*Rudbeckia hirta*	Frequent
white prairie clover	*Dalea candida*	Occasional	sweet coneflower	*Rudbeckia subtomentosa*	Sparse
purple prairie clover	*Dalea purpurea*	Frequent	little bluestem	*Schizachyrium scoparium*	Frequent
showy ticktrefoil	*Desmodium canadense*	Occasional	Maryland senna	*Senna marilandica*	Sparse
parasol whitetop	*Doellingeria umbellata*	Sparse	wholeleaf rosinweed	*Silphium integrifolium*	Occasional
tall cinquefoil	*Drymocallis arguta*	Occasional	compassplant	*Silphium laciniatum*	Occasional
pale purple coneflower	*Echinacea pallida*	Occasional	stiff goldenrod	*Solidago rigida*	Occasional
Canada wildrye	*Elymus canadensis*	Very Common	Indiangrass	*Sorghastrum nutans*	Frequent
Virginia wildrye	*Elymus virginicus*	Very Common	composite dropseed	*Sporobolus compositus*	Frequent
button eryngo	*Eryngium yuccifolium*	Sparse	white heath aster	*Symphyotrichum ericoides*	Occasional
tall thoroughwort	*Eupatorium altissimum*	Sparse	smooth blue aster	*Symphyotrichum laeve*	Sparse
common boneset	*Eupatorium perfoliatum*	Sparse	New England aster	*Symphyotrichum novae-angliae*	Occasional
flat-top goldentop	*Euthamia graminifolia*	Sparse	bluejacket	*Tradescantia ohiensis*	Sparse
fowl mannagrass	*Glyceria striata*	Sparse	swamp verbena	*Verbena hastata*	Sparse
common sneezeweed	*Helenium autumnale*	Occasional	hoary verbena	*Verbena stricta*	Frequent
sawtooth sunflower	*Helianthus grosseserratus*	Occasional	prairie ironweed	*Vernonia fasciculata*	Occasional
stiff sunflower	*Helianthus pauciflorus ssp. pauciflorus*	Occasional	American vetch	*Vicia americana*	Occasional
smooth oxeye	*Heliopsis helianthoides*	Very Common	golden zizia	*Zizia aurea*	Occasional
roundhead lespedeza	*Lespedeza capitata*	Sparse			

2019 Planting Area (third growing season)

We found 48 species throughout the 2019 planting sites, which was slightly less than we found the previous year (Table 3). There were relatively few conservative or later successional species found in this seed mix area, despite species such as compass plant, wild indigo, rattlesnake master, and blazingstar often being observable by the third growing season. We hope to find more of these important species following spring fire.

Figure 8: Typical view in July 2021 of the west hilltop looking south (seeded May 2019). Canada wildrye and switchgrass dominate the area, smooth oxeye and scattered pale purple coneflower flowering.

Table 3: Species and abundance found in the 2018 seeding areas (third growing season).

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	*Andropogon gerardii*	Frequent	roundhead lespedeza	*Lespedeza capitata*	Sparse
candle anemone	*Anemone cylindrica*	Sparse	wild bergamot	*Monarda fistulosa*	Frequent
white sagebrush	*Artemisia ludoviciana*	Occasional	marsh muhly	*Muhlenbergia racemosa*	Frequent
swamp milkweed	*Asclepias incarnata*	Sparse	biennial beeblossom	*Oenothera gaura*	Sparse
common milkweed	*Asclepias syriaca*	Occasional	switchgrass	*Panicum virgatum*	Frequent
butterfly milkweed	*Asclepias tuberosa*	Sparse	wild quinine	*Parthenium integrifolium*	Sparse
whorled milkweed	*Asclepias verticillata*	Sparse	foxglove beardtongue	*Penstemon digitalis*	Sparse
Canadian milkvetch	*Astragalus canadensis*	Occasional	whorled mountainmint	*Pycnanthemum pilosum*	Occasional
sideoats grama	*Bouteloua curtipendula*	Frequent	Virginia mountainmint	*Pycnanthemum virginianum*	Sparse
arctic brome	*Bromus kalmii*	Sparse	pinnate prairie coneflower	*Ratibida pinnata*	Very Common
stiff tickseed	*Coreopsis palmata*	Sparse	blackeyed Susan	*Rudbeckia hirta*	Sparse
tall tickseed	*Coreopsis tripteris*	Sparse	sweet coneflower	*Rudbeckia subtomentosa*	Occasional
white prairie clover	*Dalea candida*	Occasional	little bluestem	*Schizachyrium scoparium*	Frequent
purple prairie clover	*Dalea purpurea*	Frequent	wholeleaf rosinweed	*Silphium integrifolium*	Occasional
showy ticktrefoil	*Desmodium canadense*	Occasional	compassplant	*Silphium laciniatum*	Sparse
Illinois ticktrefoil	*Desmodium illinoense*	Occasional	stiff goldenrod	*Solidago rigida*	Occasional
tall cinquefoil	*Drymocallis arguta*	Sparse	Indiangrass	*Sorghastrum nutans*	Frequent
pale purple coneflower	*Echinacea pallida*	Sparse	composite dropseed	*Sporobolus compositus*	Very Common
Canada wildrye	*Elymus canadensis*	Very Common	white heath aster	*Symphyotrichum ericoides*	Occasional
Virginia wildrye	*Elymus virginicus*	Frequent	smooth blue aster	*Symphyotrichum laeve*	Frequent
common boneset	*Eupatorium perfoliatum*	Sparse	New England aster	*Symphyotrichum novae-angliae*	Occasional
flat-top goldentop	*Euthamia graminifolia*	Sparse	prairie ironweed	*Vernonia fasciculata*	Occasional
common sneezeweed	*Helenium autumnale*	Frequent	golden zizia	*Zizia aurea*	Occasional
sawtooth sunflower	*Helianthus grosseserratus*	Occasional			
smooth oxeye	*Heliopsis helianthoides*	Very Common			

2018 Planting Area (fourth growing season)

In the west hilltop area's 4th year, and following it's first prescribed burn, we observed very similar trends compared to last year- high cover of native grasses along with diverse native forbs (Fig. 9). Weed abundance was practically zero, and annual/perennial weeds combined did not exceed 5% cover. The relative amount of forbs and grasses remained essentially the same from 2020-2021 (Fig. 10).

We found 50 species throughout the planting site, which was the same as the previous year (Table 4). Species abundance was highly variable, but we found most at low abundance (1-5% cover) (Fig. 11).

This year we began observing more conservative species such as rattlesnake master, white wild indigo, and compass plant. Encouragingly, we also observed rough blazingstar, which is typically considered difficult to establish.

Much like in 2020, species composition throughout the area was characterized by a few dominant grasses (15-30% cover) (Fig. 11). While we found many other species throughout the area at 1-5% cover, the most dominant plants were switchgrass and Indiangrass. In general, most grasses other than Canada wildrye increased this year.

Figure 9: Typical view in July 2021 of the west hilltop looking south (seeded May 2018). Diverse wildflowers bloom, with pale purple coneflower, butterfly milkweed, whorled milkweed, common milkweed, and prairie coreopsis blooming amidst other species.
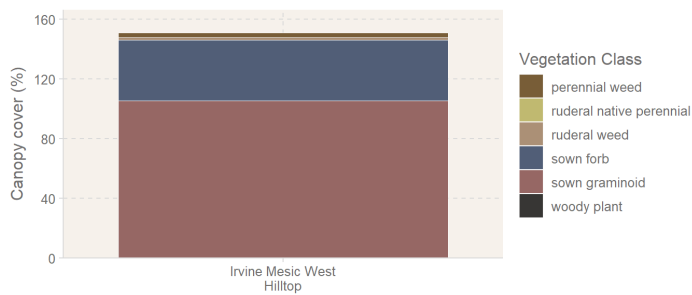
Figure 10: Canopy cover (2021) by vegetation class in 2018 planting areas. Cover may exceed 100% due to c over class use.
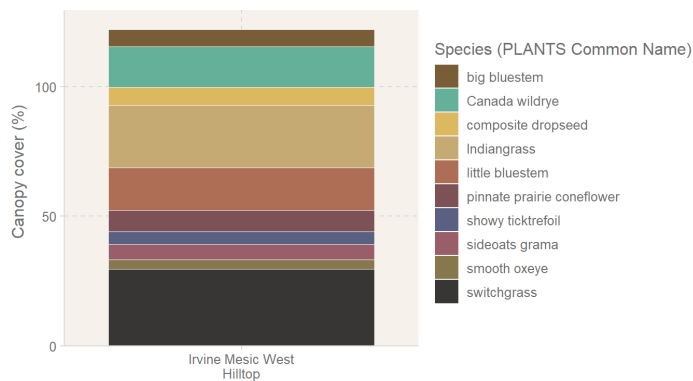

Figure 11: Canopy cover (2021) of top 10 sown species in 2018 planting areas, including ties. Cover may exceed 100% due to cover class use.

Table 4: Species and abundance found in the 2018 seeding areas (fourthgrowing season).

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	*Andropogon gerardii*	Very Common	wild bergamot	*Monarda fistulosa*	Frequen
candle anemone	*Anemone cylindrica*	Sparse	switchgrass	*Panicum virgatum*	Very Common
white sagebrush	*Artemisia ludoviciana*	Occasional	wild quinine	*Parthenium integrifolium*	Frequent
common milkweed	*Asclepias syriaca*	Frequent	foxglove beardtongue	*Penstemon digitalis*	Sparse
butterfly milkweed	*Asclepias tuberosa*	Frequent	whorled mountainmint	*Pycnanthemum pilosum*	Occasional
whorled milkweed	*Asclepias verticillata*	Frequent	Virginia mountainmint	*Pycnanthemum virginianum*	Sparse
Canadian milkvetch	*Astragalus canadensis*	Frequent	pinnate prairie coneflower	*Ratibida pinnata*	Very Common
largeleaf wild indigo	*Baptisia lactea*	Occasional	blackeyed Susan	*Rudbeckia hirta*	Occasional
sideoats grama	*Bouteloua curtipendula*	Very Common	sweet coneflower	*Rudbeckia subtomentosa*	Occasional
false boneset	*Brickellia eupatorioides*	Occasional	little bluestem	*Schizachyrium scoparium*	Very Common
arctic brome	*Bromus kalmii*	Sparse	wholeleaf rosinweed	*Silphium integrifolium*	Occasional
New Jersey tea	*Ceanothus americanus*	Sparse	compassplant	*Silphium laciniatum*	Sparse
partridge pea	*Chamaecrista fasciculata*	Sparse	stiff goldenrod	*Solidago rigida*	Occasional
stiff tickseed	*Coreopsis palmata*	Sparse	showy goldenrod	*Solidago speciosa*	Sparse
purple prairie clover	*Dalea purpurea*	Frequent	Indiangrass	*Sorghastrum nutans*	Very Common
showy ticktrefoil	*Desmodium canadense*	Frequent	composite dropseed	*Sporobolus compositus*	Frequent
Illinois ticktrefoil	*Desmodium illinoense*	Occasional	white heath aster	*Symphyotrichum ericoides*	Occasional
tall cinquefoil	*Drymocallis arguta*	Sparse	New England aster	*Symphyotrichum novae-angliae*	Frequent
pale purple coneflower	*Echinacea pallida*	Frequent	skyblue aster	*Symphyotrichum oolentangiense*	Sparse

Canada wildrye	*Elymus canadensis*	Very Common	longbract spiderwort	*Tradescantia bracteata*	Occasional
button eryngo	*Eryngium yuccifolium*	Sparse	bluejacket	*Tradescantia ohiensis*	Occasional
tall thoroughwort	*Eupatorium altissimum*	Sparse	hoary verbena	*Verbena stricta*	Occasional
sawtooth sunflower	*Helianthus grosseserratus*	Frequent	prairie ironweed	*Vernonia fasciculata*	Occasional
smooth oxeye	*Heliopsis helianthoides*	Very Common	golden zizia	*Zizia aurea*	Occasional
roundhead lespedeza	*Lespedeza capitata*	Occasional			
tall blazing star	*Liatris aspera*	Sparse			

MANAGEMENT IMPLICATIONS

Irvine Prairie continues to establish and progress well. Current site-preparation, seeding, and establishment management activities have resulted in success, and no changes in existing management techniques seem warranted.

Warm season grasses are overabundant in the 2018 planting, but are at appropriate abundance elsewhere in Irvine Prairie. In the 2018 planting, the abundance of switchgrass remained approximately 30% of native plant cover in the fourth year, while the abundance of Indiangrass increased to nearly 25%. Long-term management of this area may need to incorporate trials of grass-specific herbicide application or fall burning to prevent these two species from outcompeting smaller species. Strategies to shift seed mix design toward using more short statured grasses seems to have been successful in more recently seeded areas, as grass abundance remains below or near 50% in most parts of Irvine Prairie we measured.

Past waterways have started to show evidence of native plant establishment, likely from surrounding prairie vegetation. While the density of native plants in these areas is still quite low, few perennial weeds (other than dandelions) have colonized these areas. We will continue the passive restoration strategy in these areas, focusing on preventing invasion from serious perennial weeds (e.g. smooth brome, Canada thistle) while native species establish naturally from nearby seed sources.

Areas surrounding the 2020 earthwork and tile inlet will be more aggressively treated with grass-specific herbicide. We did not apply these herbicides initially since it was unclear whether significant amounts of native grasses had established in these areas. It is now apparent native species establishment was low. We will pursue our approach of using grass-specific herbicide to suppress non-native cool-season species while sedges and forbs are encouraged to establish through interseeding.

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