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Irvine Prairie Science Update

Justin Meissen
University of Northern Iowa

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Year 3 (2020)

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

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Introduction

We continued the restoration and maintenance of an ecologically diverse tallgrass prairie at Irvine Prairie in 2020, seeding ~ 18 ac on the back slopes and drainageways of the west-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 20 new monitoring points in 2020. 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 configuaration of the plot markers established in 2020 differs from seed mix areas planted in 2018-2019, which have pipes at the northwest and southeast corners of the plot.

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

We measured species identity, vegetation density and canopy cover metrics at each sampling location in September 2020. 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 three years old (2018 planting area.

Results

2020 Planting Area (1st Growing Season)

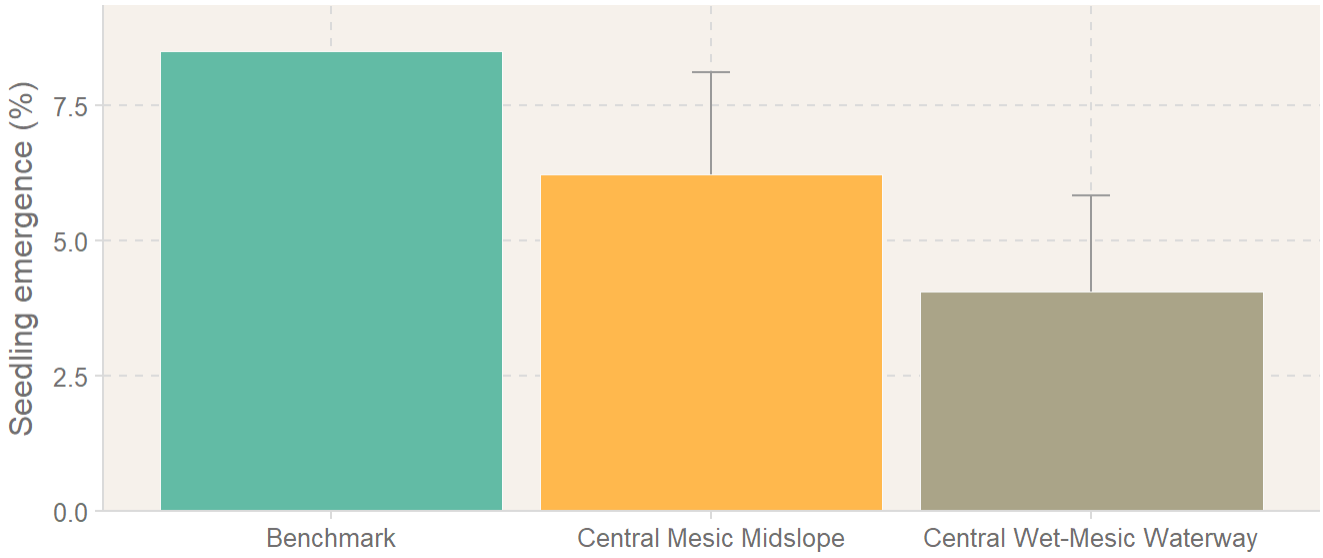

Figure 2: Seedling emergence (percent of sown seeds observed as seedlings after one growing season) in 2020 seeding areas

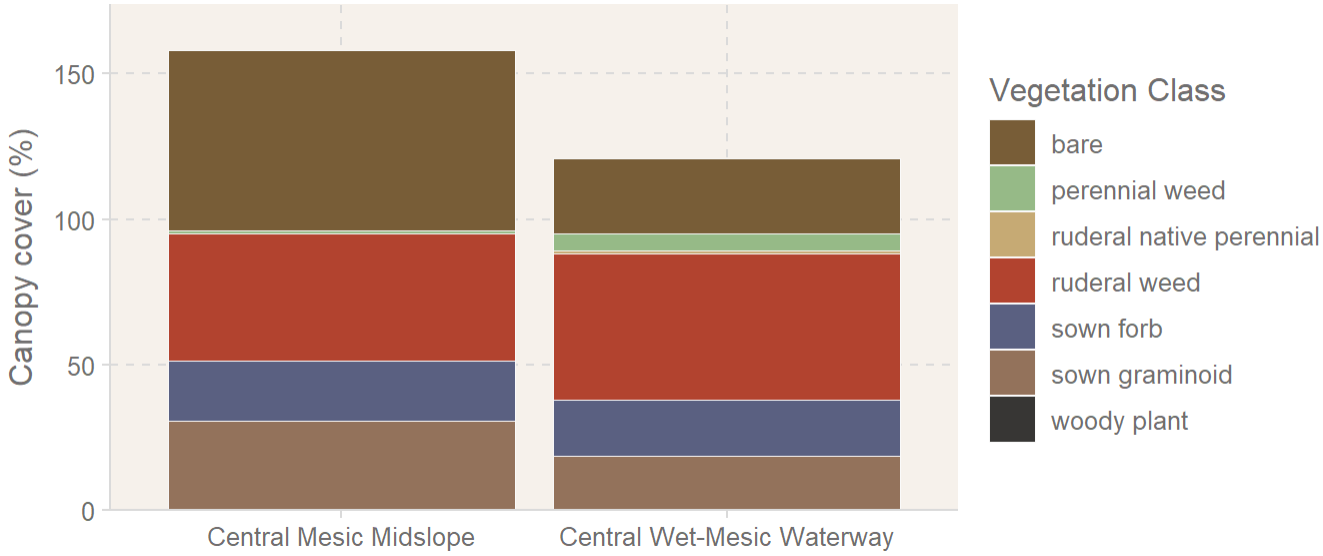

Figure 3: Canopy cover (2020) by vegetation class in 2020 planting areas. Cover may exceed 100% due to cover class use.

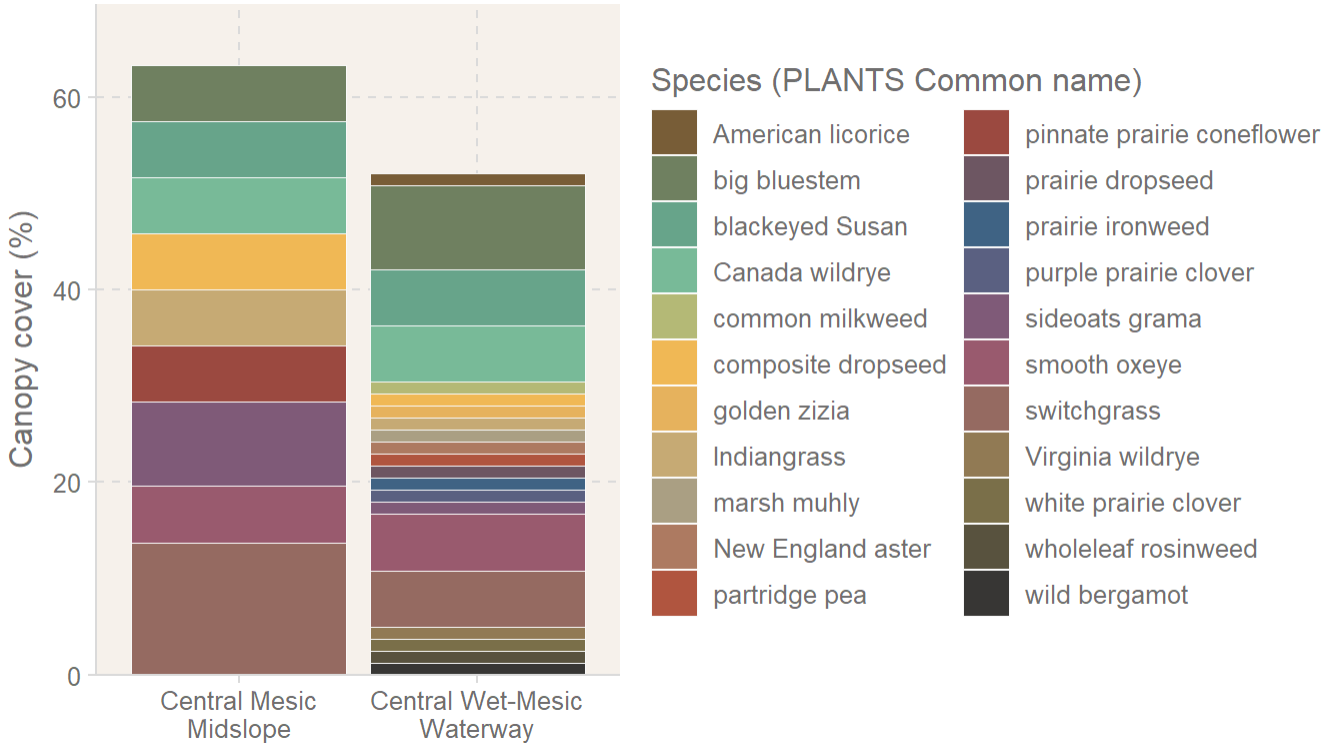

Figure 4: Canopy cover (2020) of top 10 sown species in 2020 planting areas, including ties. Cover may exceed 100% due to cover class use.

Overall, initial restoration outcomes were successful. Seeding areas did not experience washing or measurably impactful precipitation events and nurse crops and native species mostly established well across the site (Fig. 1). Dry conditions in late summer did not prevent satisfactory establishment. Weed issues were mostly restricted to high coverage of annual foxtail in foot slope and toe slope areas. Some erosion occurred in areas excavated in spring 2020, but rills were rare to absent throughout the rest of the seeding area.

Planted seed mixes established from fair to good (Fig. 2). Compared to other benchmark seed mixes, the seed mix planted on the back slope areas performed about average for a typical seeding, but slightly worse than 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 one growing season was over 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 2020 planting areas (Fig. 3). High annual weed cover in the first year is typical of most prairie reconstructions, and the high level of bare ground is likely due to dry conditions in the late-summer. The mid-slope areas had a relatively even mix of native forbs, annual weeds, and native grass. The waterway areas were very similar to the mid-slopes, but had slightly lower native grass cover. While dandelions (a perennial weed) were frequent in the waterway area, we were encouraged to find little to no other perennial weed cover in the new plantings, though encroachment from cool season

grasses was apparent from waterways and ditches. We found over 50 species throughout the planting site (Table 1). This is higher than other first year plantings, which may be due to early spring planting that allowed more forbs to break dormancy in the first season.

We found nearly all planted species at low abundance (1-5% cover) but there was high variabilty in abundance among species (Fig. 4). The most common species were big bluestem, switchgrass, and side oats grama, which were found at approximately 5% cover.

Table 1: Species and abundance found in the 2020 seeding areas (first growing season).

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

2019 Planting Area (2nd Growing Season)

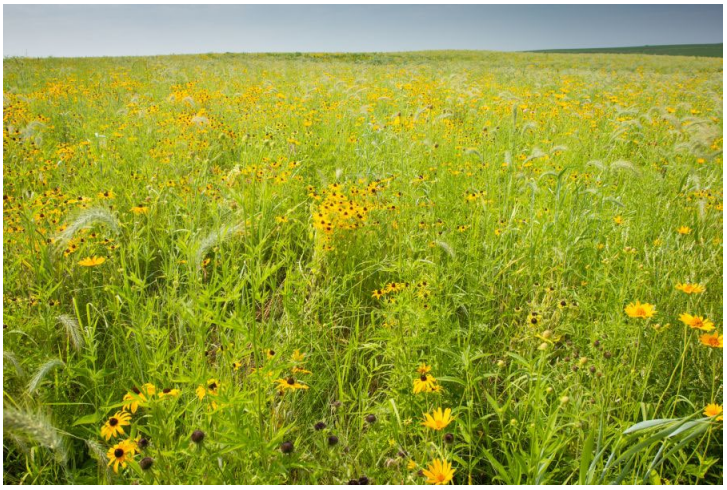

Figure 5: Typical view in July 2020 of the west lowlands looking toward west midslopes (seeded May 2019). Pinnate prairie coneflower dominates the area, with blackeyed Susan, Canada wildrye, and smooth oxeye flowering.

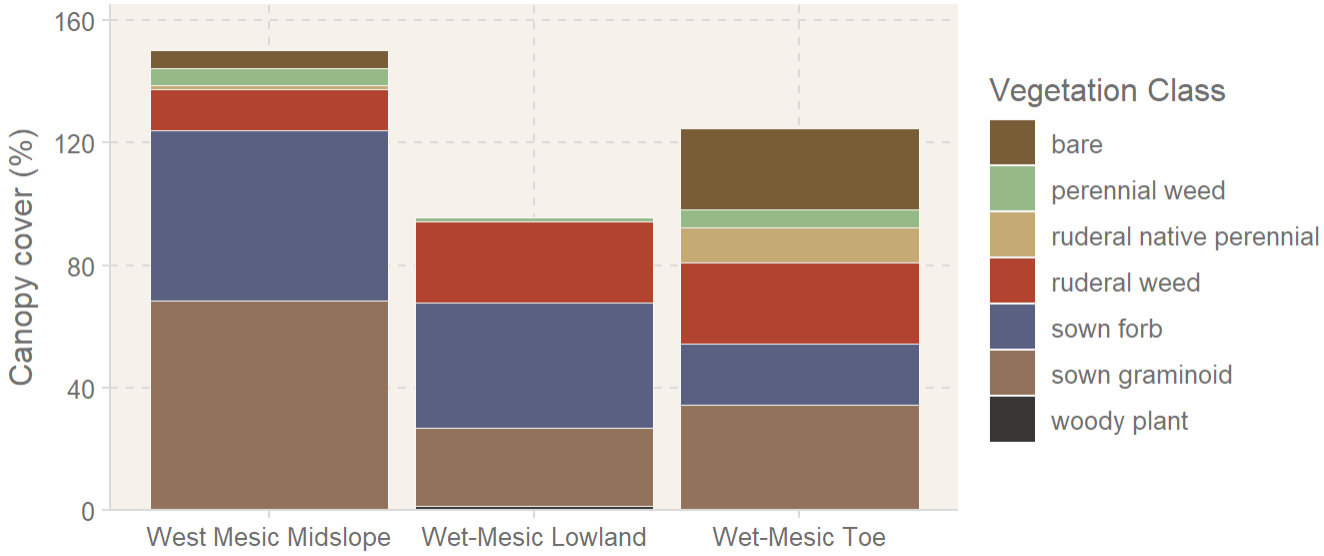

Figure 6: Canopy cover (2020) by vegetation class in 2019 planting areas. Cover may exceed 100% due to cover class use.

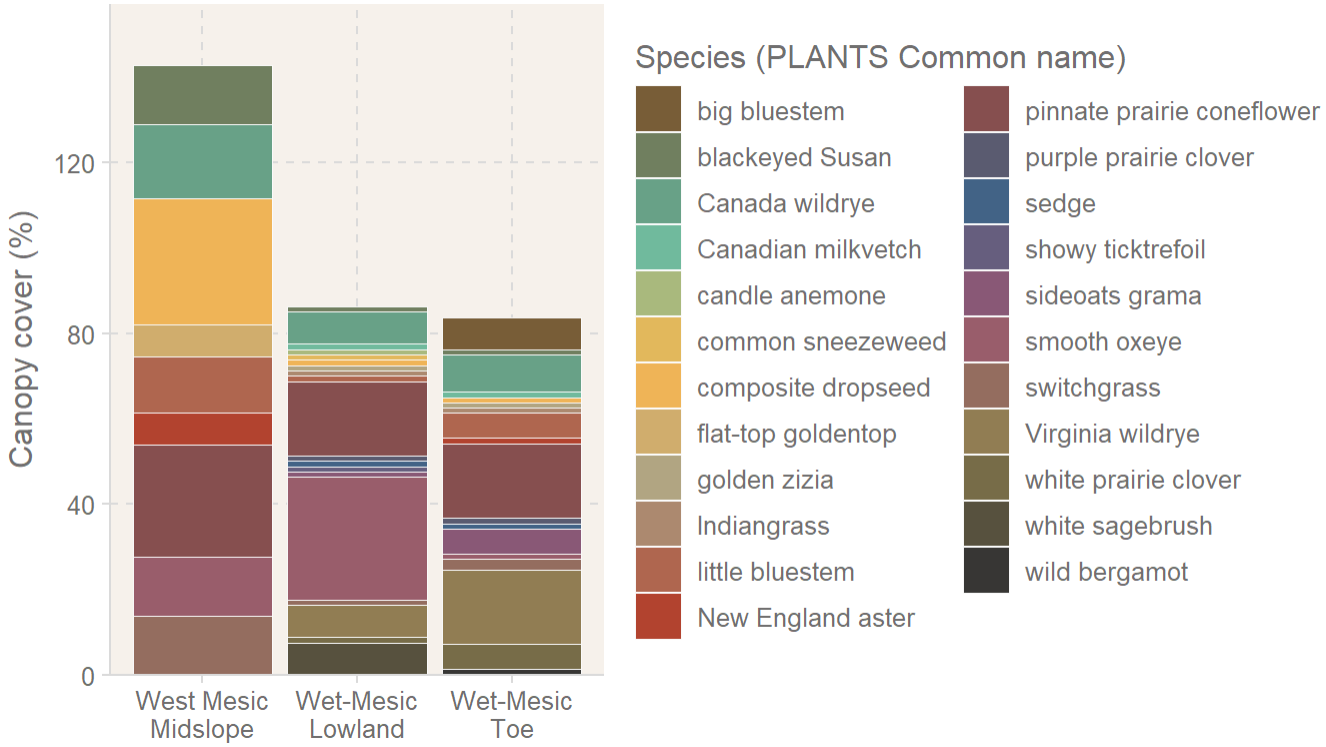

Figure 7: Canopy cover (2020) of top 10 sown species in 2019 planting areas, including ties. Cover may exceed 100% due to cover class use.

Progress toward a diverse tallgrass prairie continued on western areas of Irvine Prairie planted in 2019. 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 annual weeds remained a significant portion of vegetation in the second year. Compared to the previous year, the distinct lack of native grasses we observed was no longer apparent, and the relative coverage of native forbs and grasses was more equal (Fig. 6).

We found 48 species throughout the planting site, 7 more than we found the previous year (Table 2). Of particular interest, we observed leadplant at sparse abundance. This species typically establishes notoriously poorly from seed, but it appears at least several seedlings still exist in the 2019 planting areas in the second year.

Species abundance was highly variable, but we found most at low abundance (1-5% cover) (Fig. 7). Some species performed especially well in some sites but not others. For example, composite dropseed abundance was exceptionally high in the west mid-slope areas, with average cover nearing 30%. Should this relative dominance continue, the seeding area will be quite unique, and may support grassy vegetation that is shorter than typical tallgrass prairie recontructions. Virginia wild rye, a perennial cool season grass, was a dominant grass in the toe slope areas, with cover averaging approximately 18%. Such heterogeneity between seed mix outcomes is very encouraging, as higher heterogeneity generally leads to better outcomes for biodiversity Other species including pinnate prairie

coneflower, smooth oxeye, and blackeyed Susan were particularly common among all seed mix areas.

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

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

2018 Planting Area (3rd Growing Season)

Figure 8: Typical view in July 2020 of the west hilltop looking south (seeded May 2018). Canada wildrye and switchgrass dominate the area, smooth oxeye and scattered pale purple coneflower flowering.

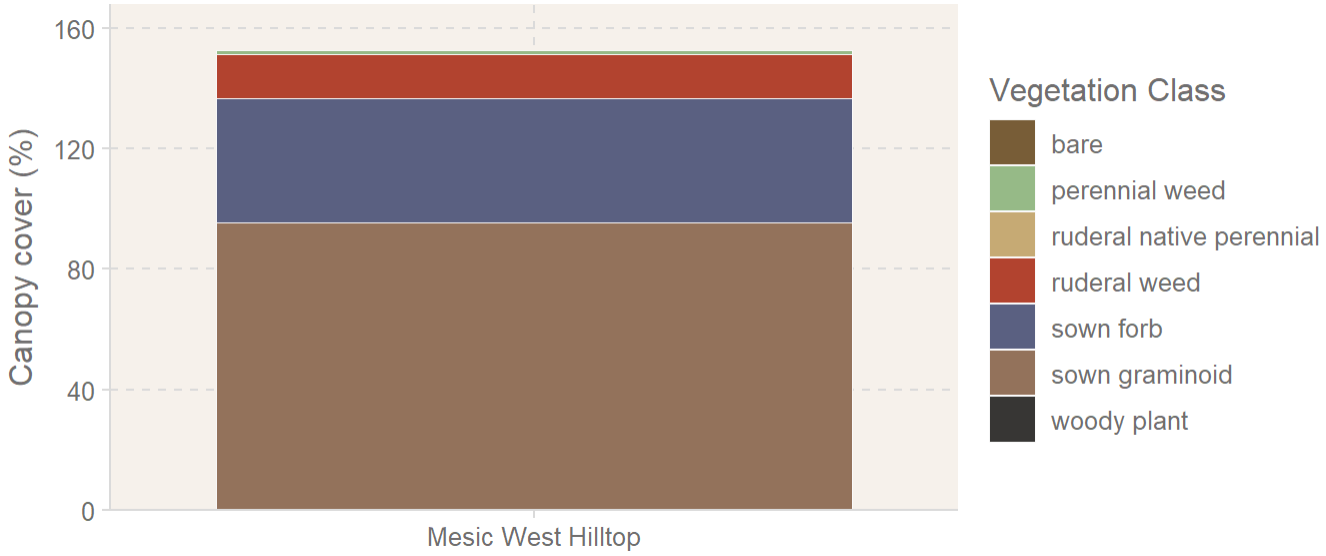

Figure 9: Canopy cover (2020) by vegetation class in 2018 planting areas. Cover may exceed 100% due to cover class use.

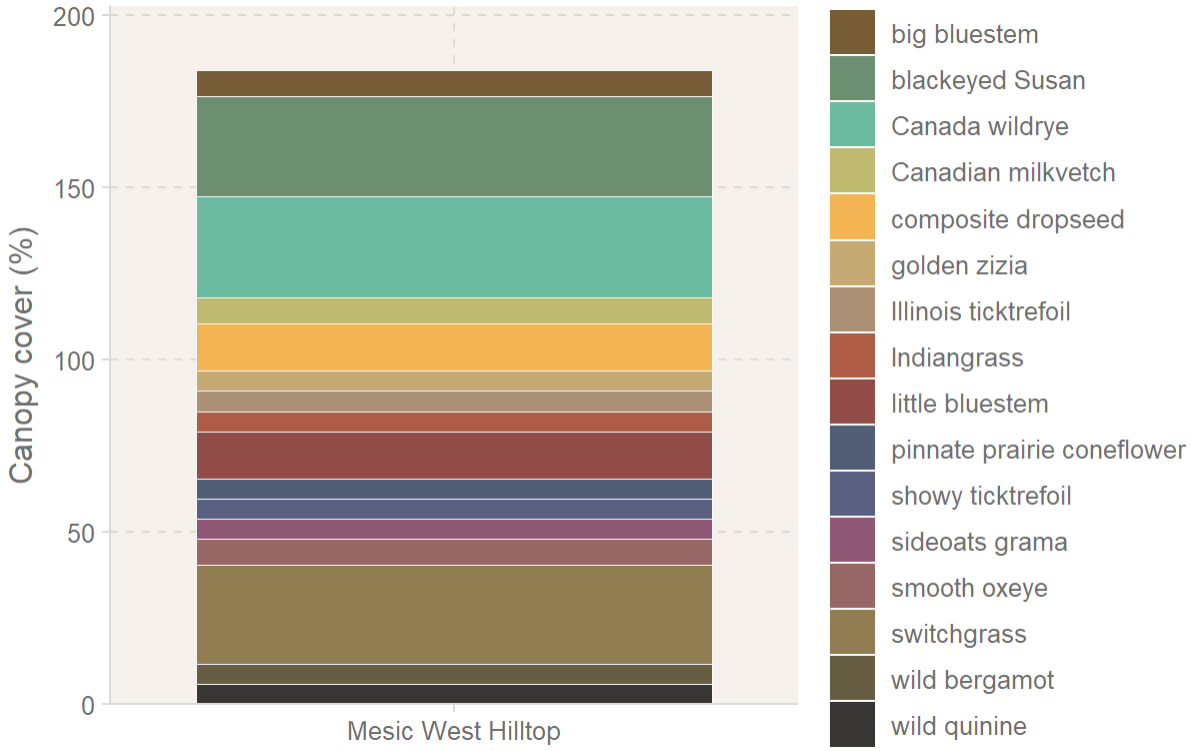

Figure 10: Canopy cover (2020) of top 10 sown species in 2018 planting areas, including ties. Cover may exceed 100% due to cover class use.

The west hilltop remained a high diversity tallgrass prairie, though vegetation trends were generally not as favorable as hoped. In this area's third year, we found that (Fig. 8). Weed abundance was reduced from the prior year, but annual weeds remained a significant portion of vegetation in the second year. Compared to the previous year, the distinct lack of native grasses we observed was no longer apparent, and the relative coverage of native forbs and grasses was more equal (Fig. 6).

We found 50 species throughout the planting site, which was the same as we found the previous year (Table 2). We are surprised that no additional conservative or later successional species were found in this seed mix area. Generally, species such as compass plant, wild indigo, rattlesnake master, and blazingstar are observed by the third growing season.

Species abundance was highly variable, but we found most at low abundance (1-5% cover) (Fig. 7). Some species performed especially well in some sites but not others. For example, composite dropseed abundance was exceptionally high in the west mid-slope areas, with average cover nearing 30%. Should this relative dominance continue, the seeding area will be quite unique, and may support grassy vegetation that is shorter than typical tallgrass prairie recontructions. Virginia wild rye, a perennial cool season grass, was a dominant grass in the toe slope areas, with cover averaging approximately 18%. Such heterogeneity between seed mix outcomes is very encouraging, as higher heterogeneity generally leads to better outcomes for biodiversity Other species including pinnate prairie

coneflower, smooth oxeye, and blackeyed Susan were particularly common among all seed mix areas.

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	switchgrass	*Panicum virgatum*	Very Common
candle anemone	*Anemone cylindrica*	Occasional	wild quinine	*Parthenium integrifolium*	Frequent
white sagebrush	*Artemisia ludoviciana*	Occasional	foxglove beardtongue	*Penstemon digitalis*	Occasional
common milkweed	*Asclepias syriaca*	Frequent	whorled mountainmint	*Pycnanthemum pilosum*	Occasional
butterfly milkweed	*Asclepias tuberosa*	Occasional	Virginia mountainmint	*Pycnanthemum virginianum*	Sparse
whorled milkweed	*Asclepias verticillata*	Occasional	pinnate prairie coneflower	*Ratibida pinnata*	Very Common
Canadian milkvetch	*Astragalus canadensis*	Frequent	blackeyed Susan	*Rudbeckia hirta*	Sparse
sideoats grama	*Bouteloua curtipendula*	Frequent	sweet coneflower	*Rudbeckia subtomentosa*	Occasional
false boneset	*Brickellia eupatorioides*	Sparse	little bluestem	*Schizachyrium scoparium*	Very Common
arctic brome	*Bromus kalmii*	Frequent	wholeleaf rosinweed	*Silphium integrifolium*	Frequent
sedge	*Carex*	Occasional	gray goldenrod	*Solidago nemoralis*	Sparse
New Jersey tea	*Ceanothus americanus*	Sparse	stiff goldenrod	*Solidago rigida*	Sparse
partridge pea	*Chamaecrista fasciculata*	Sparse	showy goldenrod	*Solidago speciosa*	Sparse
stiff tickseed	*Coreopsis palmata*	Sparse	Indiangrass	*Sorghastrum nutans*	Frequent
purple prairie clover	*Dalea purpurea*	Frequent	composite dropseed	*Sporobolus compositus*	Frequent
showy ticktrefoil	*Desmodium canadense*	Frequent	white heath aster	*Symphyotrichum ericoides*	Occasional
Illinois ticktrefoil	*Desmodium illinoense*	Occasional	smooth blue aster	*Symphyotrichum laeve*	Sparse
tall cinquefoil	*Drymocallis arguta*	Sparse	New England aster	*Symphyotrichum novae-angliae*	Occasional
pale purple coneflower	*Echinacea pallida*	Frequent	longbract spiderwort	*Tradescantia bracteata*	Frequent
Canada wildrye	*Elymus canadensis*	Very Common	bluejacket	*Tradescantia ohiensis*	Frequent
tall thoroughwort	*Eupatorium altissimum*	Sparse	hoary verbena	*Verbena stricta*	Sparse
flat-top goldentop	*Euthamia graminifolia*	Sparse	prairie ironweed	*Vernonia fasciculata*	Occasional
sawtooth sunflower	*Helianthus grosseserratus*	Frequent	prairie violet	*Viola pedatifida*	Sparse
smooth oxeye	*Heliopsis helianthoides*	Frequent	golden zizia	*Zizia aurea*	Occasional
roundhead lespedeza	*Lespedeza capitata*	Occasional			
wild bergamot	*Monarda fistulosa*	Frequent			

Management Implications

Based on our results from 2020 monitoring, Irvine Prairie continues to establish and progress satisfactorily. Areas we identified last year as potentially needing targeted management improved significantly and while continued monitoring is warranted, no additional management is necessary. Current site-preparation, seeding, and establishment management activities have resulted in success, and no changes in management techniques are needed.

Due to less than expected establishment rates, the majority of low lying areas in the 2019 planting area should be closely monitored and mowed again in 2020 to promote growth of native seedlings. It is unclear why establishment rates were so low, though in part it is probably related to lower seeding rates and less ideal conditions (too wet) for important grasses like rough dropseed and side-oats grama, which established very well in drier areas. Assuming sown seeds that did not germinate remain viable and unburied, mowing should encourage more seedling establishment when seedlings emerge this year.

Switchgrass continued to overperform in 2018 plantings, but moderated its growth in all other areas of Irvine Prairie. In the 2018 planting, the relative abundance of switchgrass increased to 30% of native plant cover in the third year. This level of abundance exceeds 25% of native plant cover, and we will initiate late spring burning in this area which may help reduce switchgrass cover (Blocksome 2011). The amount of switchgrass in our seed mix continued to result in acceptable abundance in the 2020 planting areas, and seed mixes sown on new planting areas will continue to use switchgrass seeding rates similar to those sown in 2019.

Former waterways and adjacent areas throughout Irvine Prairie are proving to be difficult for native species establishment.

Acknowledgements

We thank Jared Randall and Paige Shafer for field support in data collection and research plot management.

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