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Irvine Prairie Science Update

C. Irvine

B. Pippert

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Authors

C. Irvine, B. Pippert, Laura Jackson, Justin Meissen, Laura Walter, Andrew Olson, and Anne Phillips

IRVINE PRAIRIE

Winter Meeting | March 1, 2023

C. Irvine, B. Pippert, L. Jackson, J. Meissen, L. Walter,
A. Olson, A. Phillips



Tallgrass Prairie
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University of Northern Iowa.

Science Update

2022



Irvine Prairie Science Update

Year 5 (2022)

Introduction

We continued the restoration and maintenance of an ecologically diverse tallgrass prairie at Irvine Prairie in 2022, seeding the final ~ 15 ac of farmed land (of the initial 77 acres planned) on east end of the site. We monitor our progress through detailed vegetation sampling to make sure our restoration methods continue to be effective. 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. 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 2022. Each permanent plot consists of two steel pipes recessed into the ground at the corners (southwest and northeast) of a 1 m² 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 2022 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 and vegetation density metrics at sampling locations in September 2022.

To sample plant composition at each random point, we used a modified nested quadrat sampling method described in the National Protocol Framework for Monitoring Vegetation in Prairie Reconstructions (McColpin et al. 2019). In this method, observers record plant identity and presence in a series of nested quadrats (0.0625, 0.125, 0.25, 0.5, and 1m²). We additionally measured density of sown species in the 0.125 m² quadrats, where we counted and identified all individuals (ramets) of seeded species >10 cm tall. We calculated frequency and species richness metrics using the 1 m² quadrat measurements.

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: Very Common, Frequent, Occasional, Sparse. See (McColpin et al. 2019) for a detailed description of the method used for meandering walk surveys.

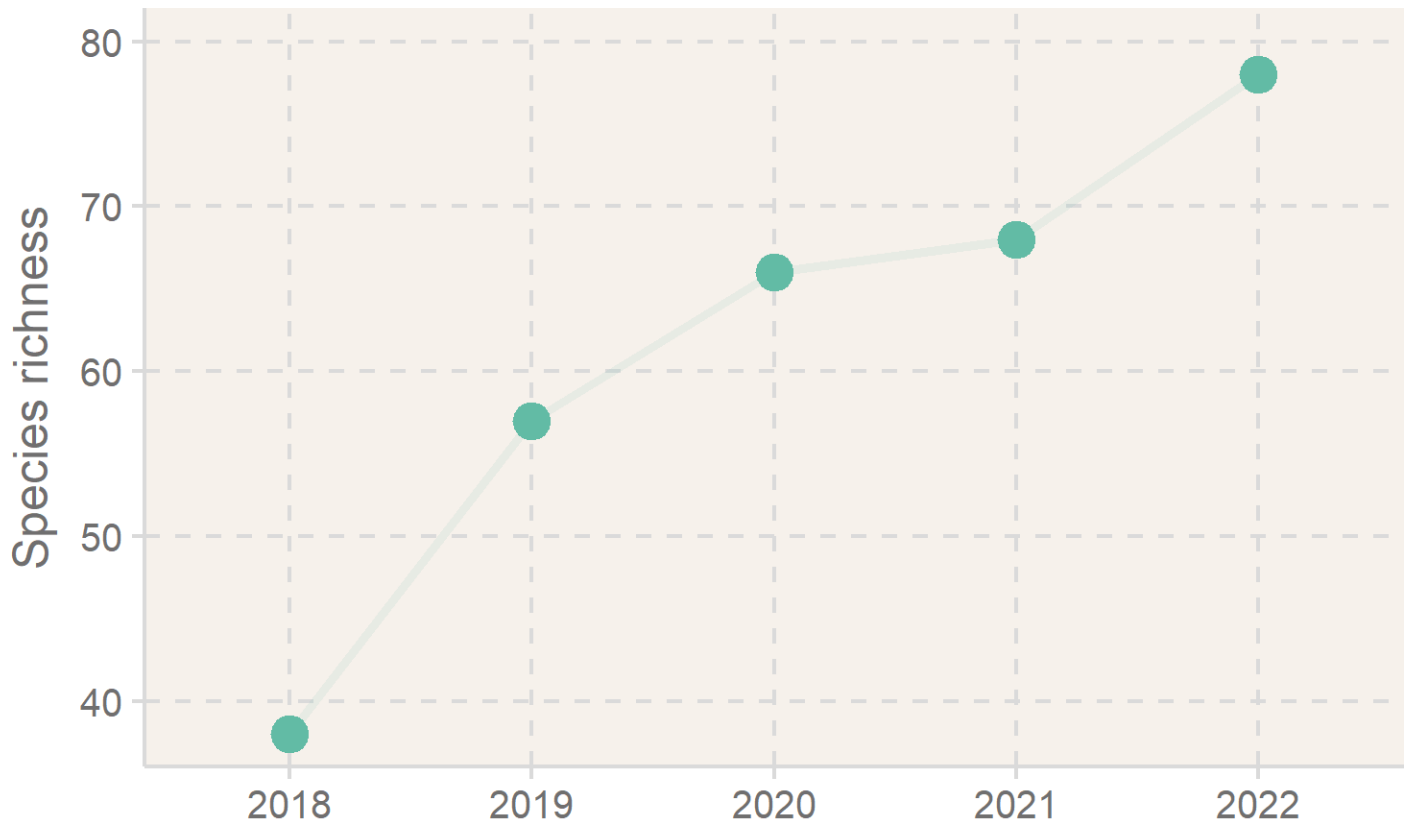


Figure 1: Overall site plant species richness (walkthrough data)

Results

Irvine Prairie Overall

We seeded and transplanted 84 species of native plants in fall 2021 and spring 2022, across a total of 15 acres. With the addition of that work, total acres restored at Irvine Prairie has reached 76 acres using 128 species. Additional restoration was conducted in fall 2022 which will be discussed in the 2023 Science Report. In the 2022 growing season, we found 78 species across Irvine Prairie (Fig. 1). Over all our years of monitoring, including this year, we have found 84 unique plant species. We are encouraged to find species diversity continuously increasing.

2022 Planting Area (second growing season)



Figure 2: Typical view in July of the eastern uplands (seeded Nov 2021/ Apr 2022). Area recently hayed to increase light availability for seedlings

We tried two different methods with our Northeast and Southeast Mesic Midslope Areas. We broadcast seeded in the fall on the Southeast Midslopes, and drill seeded in the spring in the Northeast Midslopes. We also worked with a local cattle producer to hay the site in mid summer rather than simply mow. (Fig. 2). Weed issues, primarily due to prickly lettuce (*Lactuca serriola*), were localized. However, a serious brome invasion has developed near the road on the north edge which was sprayed prior to seeding (with mixed results). Cover crops and low topography prevented any erosion issues.

Overall, planted seed mixes established satisfactorily in both the dormant broadcast Southeast Midslope and the spring drilled Northeast Midslope (Fig. 3). Compared to other benchmark seed mixes, establishment was less than our Nashua Experiment site but considerably higher than the the rule-of-thumb minimum for successful prairie reconstruction (10 individuals/m²) (Smith et al. 2010).

Vegetation structure was mostly dominated by annual weeds in the 2022 planting areas, as is typical for new plantings (Fig. 4). In terms of the relative abundance of plant functional groups, the dormant broadcast area was more evenly composed of all functional groups compared to the spring drilled area. The spring drilled area was missing spring forbs entirely and included few cool season grasses while the dormant broadcast area was comprised relatively evenly of all functional groups.

We found 43 species throughout both planting sites (Table 1), but there were large differences in the dormant broadcast vs spring drilled areas. The dormant broadcast area produced 39 species, over twice as many as the spring drilled area (17 species).

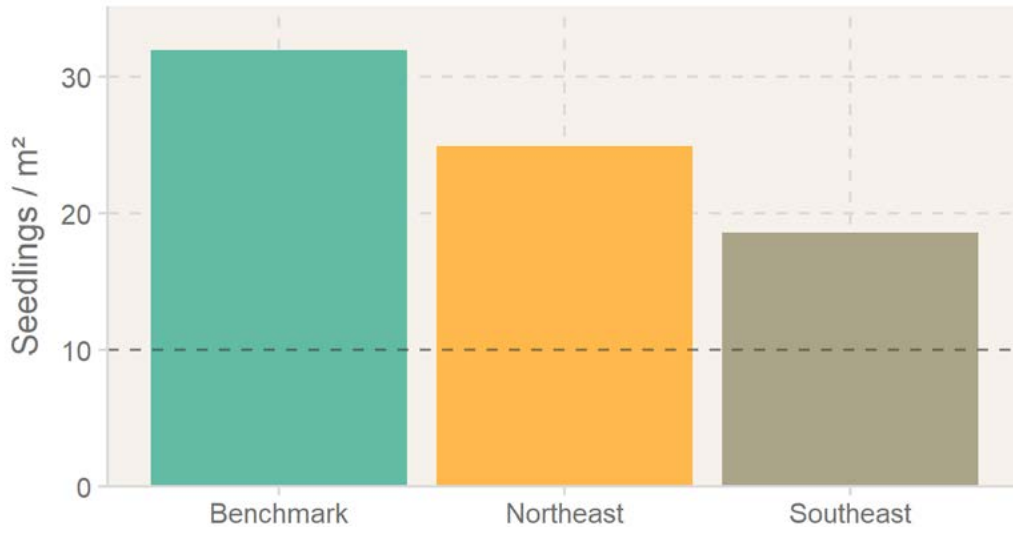


Figure 3: : Seedling emergence (sown seedling density after one growing season) in 2022 seeding areas

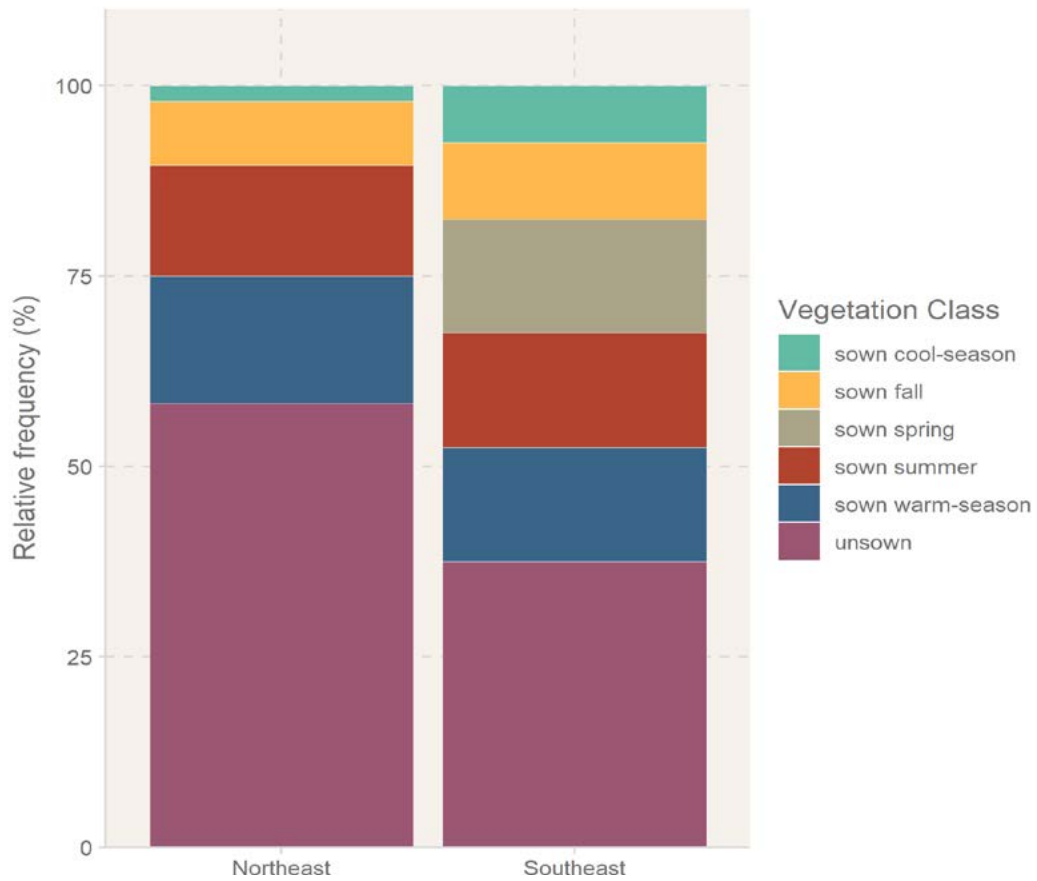


Figure 4: Relative frequency (2022) by vegetation class in 2022 planting areas

Table 1: Species and abundance found in the 2022 seeding areas (first growing season)

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	<i>Andropogon gerardii</i>	Sparse	biennial beeblossom	<i>Oenothera gaura</i>	Sparse
white sagebrush	<i>Artemisia ludoviciana</i>	Sparse	wild quinine	<i>Parthenium integrifolium</i>	Occasional
prairie milkweed	<i>Asclepias sullivantii</i>	Sparse	foxglove beardtongue	<i>Penstemon digitalis</i>	Frequent
common milkweed	<i>Asclepias syriaca</i>	Occasional	pinnate prairie coneflower	<i>Ratibida pinnata</i>	Very Common
butterfly milkweed	<i>Asclepias tuberosa</i>	Sparse	blackeyed Susan	<i>Rudbeckia hirta</i>	Frequent
whorled milkweed	<i>Asclepias verticillata</i>	Sparse	sweet coneflower	<i>Rudbeckia subtomentosa</i>	Occasional
Canadian milkvetch	<i>Astragalus canadensis</i>	Frequent	little bluestem	<i>Schizachyrium scoparium</i>	Frequent
sideoats grama	<i>Bouteloua curtipendula</i>	Very Common	wholeleaf rosinweed	<i>Silphium integrifolium</i>	Occasional
false boneset	<i>Brickellia eupatorioides</i>	Sparse	stiff goldenrod	<i>Solidago rigida</i>	Occasional
partridge pea	<i>Chamaecrista fasciculata</i>	Sparse	showy goldenrod	<i>Solidago speciosa</i>	Frequent
white prairie clover	<i>Dalea candida</i>	Sparse	Indiangrass	<i>Sorghastrum nutans</i>	Sparse
purple prairie clover	<i>Dalea purpurea</i>	Frequent	composite dropseed	<i>Sporobolus compositus</i>	Very Common
showy ticktrefoil	<i>Desmodium canadense</i>	Sparse	smooth blue aster	<i>Symphyotrichum laeve</i>	Occasional
Illinois ticktrefoil	<i>Desmodium illinoense</i>	Sparse	New England aster	<i>Symphyotrichum novae-angliae</i>	Sparse
tall cinquefoil	<i>Drymocallis arguta</i>	Frequent	skyblue aster	<i>Symphyotrichum oolentangiense</i>	Sparse
pale purple coneflower	<i>Echinacea pallida</i>	Frequent	purple meadow-rue	<i>Thalictrum dasycarpum</i>	Sparse
Canada wildrye	<i>Elymus canadensis</i>	Sparse	hoary verbena	<i>Verbena stricta</i>	Frequent
Virginia wildrye	<i>Elymus virginicus</i>	Frequent	prairie ironweed	<i>Vernonia fasciculata</i>	Occasional
stiff sunflower	<i>Helianthus pauciflorus ssp. pauciflorus</i>	Occasional	prairie violet	<i>Viola pedatifida</i>	Sparse
smooth oxeye	<i>Heliopsis helianthoides</i>	Frequent	meadow zizia	<i>Zizia aptera</i>	Occasional
prairie blazing star	<i>Liatris pycnostachya</i>	Sparse	golden zizia	<i>Zizia aurea</i>	Frequent
wild bergamot	<i>Monarda fistulosa</i>	Sparse			

2021 Planting Area (second growing season)



Figure 5: Typical view in July of the eastern midslopes looking south (seeded Apr 2021). Blackeyed Susan, Canada wildrye, and smooth oxeye flowering.

East central areas of Irvine Prairie planted in 2021 performed very well this year (Fig. 5). We found 47 species throughout the planting site, more than we found the previous year (Table 2). Species abundance was highly variable, but we found most at low abundance (sparse to occasional). The dry-mesic planting performed especially well, and we found several interesting new species such as spotted beebalm, wild petunia, aromatic aster, and flowering spurge. Typical early successional species were dominant, including both Virginia and Canada wild rye. 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. An uncharacteristically high abundance of side oats grama exists along most upland areas.

Table 2: Species and abundance found in the 2021 seeding areas (second growing season)

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	<i>Andropogon gerardii</i>	Very Common	sawtooth sunflower	<i>Helianthus grosseserratus</i>	Sparse
white sagebrush	<i>Artemisia ludoviciana</i>	Very Common	stiff sunflower	<i>Helianthus pauciflorus</i> ssp. <i>pauciflorus</i>	Frequent
swamp milkweed	<i>Asclepias incarnata</i>	Occasional	smooth oxeye	<i>Heliopsis helianthoides</i>	Very Common
common milkweed	<i>Asclepias syriaca</i>	Occasional	roundhead lespedeza	<i>Lespedeza capitata</i>	Occasional
butterfly milkweed	<i>Asclepias tuberosa</i>	Sparse	wild bergamot	<i>Monarda fistulosa</i>	Frequent
whorled milkweed	<i>Asclepias verticillata</i>	Occasional	spotted beebalm	<i>Monarda punctata</i>	Sparse
Canadian milkvetch	<i>Astragalus canadensis</i>	Occasional	marsh muhly	<i>Muhlenbergia racemosa</i>	Occasional
sideoats grama	<i>Bouteloua curtipendula</i>	Very Common	switchgrass	<i>Panicum virgatum</i>	Occasional
false boneset	<i>Brickellia eupatorioides</i>	Frequent	wild quinine	<i>Parthenium integrifolium</i>	Occasional
arctic brome	<i>Bromus kalmii</i>	Sparse	pinnate prairie coneflower	<i>Ratibida pinnata</i>	Very Common
partridge pea	<i>Chamaecrista fasciculata</i>	Frequent	blackeyed Susan	<i>Rudbeckia hirta</i>	Very Common
stiff tickseed	<i>Coreopsis palmata</i>	Sparse	fringeleaf wild petunia	<i>Ruellia humilis</i>	Sparse
tall tickseed	<i>Coreopsis tripteris</i>	Sparse	little bluestem	<i>Schizachyrium scoparium</i>	Frequent
white prairie clover	<i>Dalea candida</i>	Occasional	wholeleaf rosinweed	<i>Silphium integrifolium</i>	Frequent
purple prairie clover	<i>Dalea purpurea</i>	Frequent	compassplant	<i>Silphium laciniatum</i>	Sparse
Illinois bundleflower	<i>Desmanthus illinoensis</i>	Sparse	stiff goldenrod	<i>Solidago rigida</i>	Sparse
showy ticktrefoil	<i>Desmodium canadense</i>	Occasional	Indiangrass	<i>Sorghastrum nutans</i>	Frequent
Illinois ticktrefoil	<i>Desmodium illinoense</i>	Occasional	composite dropseed	<i>Sporobolus compositus</i>	Frequent
pale purple coneflower	<i>Echinacea pallida</i>	Sparse	white heath aster	<i>Symphotrichum ericoides</i>	Occasional
Canada wildrye	<i>Elymus canadensis</i>	Very Common	smooth blue aster	<i>Symphotrichum laeve</i>	Sparse
Virginia wildrye	<i>Elymus virginicus</i>	Very Common	New England aster	<i>Symphotrichum novae-angliae</i>	Occasional
tall thoroughwort	<i>Eupatorium altissimum</i>	Sparse	aromatic aster	<i>Symphotrichum oblongifolium</i>	Occasional
flowering spurge	<i>Euphorbia corollata</i>	Sparse	hoary verbena	<i>Verbena stricta</i>	Occasional
common sneezeweed	<i>Helenium autumnale</i>	Sparse			

2020 Planting Area (third growing season)



Figure 6: Typical view in July of the central midslopes looking south (seeded May 2020). Pinnate prairie coneflower and smooth oxeye dominates the area, with beebalm and Canada milkvetch blooming.

We observed good outcomes this year in the central areas of Irvine Prairie planted in 2020. In this area's third year, we observed early successional species transitioning to later successional species and high native abundance (Fig. 6). We found 43 species throughout the planting site, slightly fewer than the previous year (Table 2). Species abundance varied, but we found overall lower abundance of warm-season grasses in this planting, where typically very common dominant grasses (e.g. big bluestem) were found only frequently. We also found relatively high abundance of some conservative species such as compassplant and rattlesnake master in the mesic areas. Lowland areas were still strongly dominated by Virginia wild rye, but many wet prairie species like sneezeweed, boneset, marsh muhly, and swamp milkweed were well represented there.

The two-acre area broadcast seeded in fall 2019 was again characterized by limited establishment of native species. Annual weeds still dominated the area vegetation, though native plants continued to emerge at 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. Limited spread of perennial weeds and the continued establishment of native species suggests satisfactory restoration will occur passively over many years.

Table 3: Species and abundance found in the 2020 seeding areas (third growing season)

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	<i>Andropogon gerardii</i>	Frequent	smooth oxeye	<i>Heliopsis helianthoides</i>	Very Common
white sagebrush	<i>Artemisia ludoviciana</i>	Occasional	roundhead lespedeza	<i>Lespedeza capitata</i>	Occasional
swamp milkweed	<i>Asclepias incarnata</i>	Occasional	American water horehound	<i>Lycopus americanus</i>	Sparse
common milkweed	<i>Asclepias syriaca</i>	Occasional	wild bergamot	<i>Monarda fistulosa</i>	Frequent
whorled milkweed	<i>Asclepias verticillata</i>	Sparse	marsh muhly	<i>Muhlenbergia racemosa</i>	Occasional
Canadian milkvetch	<i>Astragalus canadensis</i>	Frequent	switchgrass	<i>Panicum virgatum</i>	Occasional
sideoats grama	<i>Bouteloua curtipendula</i>	Very Common	wild quinine	<i>Parthenium integrifolium</i>	Frequent
false boneset	<i>Brickellia eupatorioides</i>	Sparse	obedient plant	<i>Physostegia virginiana</i>	Sparse
partridge pea	<i>Chamaecrista fasciculata</i>	Sparse	whorled mountainmint	<i>Pycnanthemum pilosum</i>	Sparse
tall tickseed	<i>Coreopsis tripteris</i>	Occasional	pinnate prairie coneflower	<i>Ratibida pinnata</i>	Very Common
white prairie clover	<i>Dalea candida</i>	Sparse	blackeyed Susan	<i>Rudbeckia hirta</i>	Frequent
purple prairie clover	<i>Dalea purpurea</i>	Occasional	little bluestem	<i>Schizachyrium scoparium</i>	Frequent
showy ticktrefoil	<i>Desmodium canadense</i>	Frequent	wholeleaf rosinweed	<i>Silphium integrifolium</i>	Frequent
Illinois ticktrefoil	<i>Desmodium illinoense</i>	Occasional	compassplant	<i>Silphium laciniatum</i>	Occasional
tall cinquefoil	<i>Drymocallis arguta</i>	Sparse	stiff goldenrod	<i>Solidago rigida</i>	Occasional
pale purple coneflower	<i>Echinacea pallida</i>	Sparse	showy goldenrod	<i>Solidago speciosa</i>	Sparse
Canada wildrye	<i>Elymus canadensis</i>	Very Common	Indiangrass	<i>Sorghastrum nutans</i>	Frequent
Virginia wildrye	<i>Elymus virginicus</i>	Very Common	composite dropseed	<i>Sporobolus compositus</i>	Frequent
button eryngo	<i>Eryngium yuccifolium</i>	Occasional	white heath aster	<i>Symphotrichum ericoides</i>	Frequent
tall thoroughwort	<i>Eupatorium altissimum</i>	Occasional	smooth blue aster	<i>Symphotrichum laeve</i>	Sparse
common boneset	<i>Eupatorium perfoliatum</i>	Occasional	New England aster	<i>Symphotrichum novae-angliae</i>	Occasional
flowering spurge	<i>Euphorbia corollata</i>	Sparse	hoary verbena	<i>Verbena stricta</i>	Occasional
flat-top goldentop	<i>Euthamia graminifolia</i>	Occasional	prairie ironweed	<i>Vernonia fasciculata</i>	Occasional
common sneezeweed	<i>Helenium autumnale</i>	Occasional	American vetch	<i>Vicia americana</i>	Sparse
sawtooth sunflower	<i>Helianthus grosseserratus</i>	Frequent	golden zizia	<i>Zizia aurea</i>	Occasional
stiff sunflower	<i>Helianthus pauciflorus</i> ssp. <i>pauciflorus</i>	Frequent			

2019 Planting Area (fourth growing season)

After a prescribed burn in April, we found 53 species throughout the 2019 planting sites, an increase from the previous year (Table 4). Several species seemed to flourish after the burn, especially legumes. White prairie clover and purple prairie clover flowered extensively and were especially abundant, and tick trefoil species flowered abundantly as well (Fig. 7). We also began to find more conservative species such as white wild indigo, rattlesnake master and leadplant.

While big bluestem and Indiangrass were very common throughout, composite dropseed was a dominant grass in several west facing slope areas, making the overall plant community structure shorter than typical prairie restorations. Encouragingly, we found several populations of prairie cord grass in the lowlands, which gives potential for these areas to develop a characteristic wet prairie structure as they spread.



Figure 7: Typical view in July of the west hilltop looking south (seeded May 2019). Diverse tallgrass mixture dominates the area; smooth oxeye, white and purple prairie clover, wild quinine, and others flowering.

Table 4: Species and abundance found in the 2019 seeding areas (fourth growing season)

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

2018 Planting Area (fifth growing season)

High cover of native grasses along with diverse native forbs characterized the west hilltop this year (Fig. 8). We found 51 species throughout the planting site, which was about the same as the previous year (Table 5). We continued observing conservative species such as sky-blue aster, New Jersey tea, and compassplant. This area continues to support an exceptional stand of milkweed species.

Butterfly milkweed, whorled milkweed and common milkweed were all frequent to very common in this area, making the hilltop prime monarch habitat. Much like in 2022, species composition throughout the area was characterized by a few dominant grasses, specifically switchgrass and big bluestem.



Figure 8: Typical view in July of the west hilltop looking south (seeded May 2018). Switchgrass, indiangrass and big bluestem dominate, with pinnacone and showy tick trefoil about to bloom.

Table 5: Species and abundance found in the 2018 seeding areas (f growing season)

Common Name	Scientific Name	Abundance	Common Name	Scientific Name	Abundance
big bluestem	<i>Andropogon gerardii</i>	Very Common	roundhead lespedeza	<i>Lespedeza capitata</i>	Occasional
candle anemone	<i>Anemone cylindrica</i>	Occasional	wild bergamot	<i>Monarda fistulosa</i>	Frequent
white sagebrush	<i>Artemisia ludoviciana</i>	Occasional	switchgrass	<i>Panicum virgatum</i>	Very Common
common milkweed	<i>Asclepias syriaca</i>	Frequent	wild quinine	<i>Parthenium integrifolium</i>	Frequent
butterfly milkweed	<i>Asclepias tuberosa</i>	Very Common	foxglove beardtongue	<i>Penstemon digitalis</i>	Occasional
whorled milkweed	<i>Asclepias verticillata</i>	Very Common	whorled mountainmint	<i>Pycnanthemum pilosum</i>	Occasional
Canadian milkvetch	<i>Astragalus canadensis</i>	Frequent	pinnate prairie coneflower	<i>Ratibida pinnata</i>	Very Common
largeleaf wild indigo	<i>Baptisia lactea</i>	Occasional	blackeyed Susan	<i>Rudbeckia hirta</i>	Very Common
sideoats grama	<i>Bouteloua curtipendula</i>	Very Common	sweet coneflower	<i>Rudbeckia subtomentosa</i>	Frequent
false boneset	<i>Brickellia eupatorioides</i>	Occasional	little bluestem	<i>Schizachyrium scoparium</i>	Very Common
arctic brome	<i>Bromus kalmii</i>	Sparse	wholeleaf rosinweed	<i>Silphium integrifolium</i>	Occasional
New Jersey tea	<i>Ceanothus americanus</i>	Sparse	compassplant	<i>Silphium laciniatum</i>	Sparse
partridge pea	<i>Chamaecrista fasciculata</i>	Occasional	stiff goldenrod	<i>Solidago rigida</i>	Occasional
stiff tickseed	<i>Coreopsis palmata</i>	Sparse	showy goldenrod	<i>Solidago speciosa</i>	Occasional
purple prairie clover	<i>Dalea purpurea</i>	Frequent	Indiangrass	<i>Sorghastrum nutans</i>	Very Common
showy ticktrefoil	<i>Desmodium canadense</i>	Frequent	composite dropseed	<i>Sporobolus compositus</i>	Frequent
Illinois ticktrefoil	<i>Desmodium illinoense</i>	Very Common	white heath aster	<i>Symphotrichum ericoides</i>	Occasional
tall cinquefoil	<i>Dryocallis arguta</i>	Sparse	smooth blue aster	<i>Symphotrichum laeve</i>	Sparse
pale purple coneflower	<i>Echinacea pallida</i>	Frequent	New England aster	<i>Symphotrichum novae-angliae</i>	Occasional
Canada wildrye	<i>Elymus canadensis</i>	Sparse	skyblue aster	<i>Symphotrichum oolentangiense</i>	Sparse
button eryngo	<i>Eryngium yuccifolium</i>	Occasional	longbract spiderwort	<i>Tradescantia bracteata</i>	Occasional
tall thoroughwort	<i>Eupatorium altissimum</i>	Sparse	bluejacket	<i>Tradescantia ohioensis</i>	Occasional
flat-top goldentop	<i>Euthamia graminifolia</i>	Sparse	hoary verbena	<i>Verbena stricta</i>	Occasional
northern bedstraw	<i>Galium boreale</i>	Sparse	prairie ironweed	<i>Vernonia fasciculata</i>	Sparse
sawtooth sunflower	<i>Helianthus grosseserratus</i>	Occasional	golden zizia	<i>Zizia aurea</i>	Frequent
smooth oxeye	<i>Heliopsis helianthoides</i>	Very Common			

Cool Season Grass Enhancement Experiment

In addition to general monitoring at Irvine Prairie, we also established a formal replicated, randomized field experiment this year. We investigated the required site prep for successful prairie establishment into cool season grass stands. We assessed herbicide frequency (0x, 1x, 2x applications of 2qt/ac Roundup

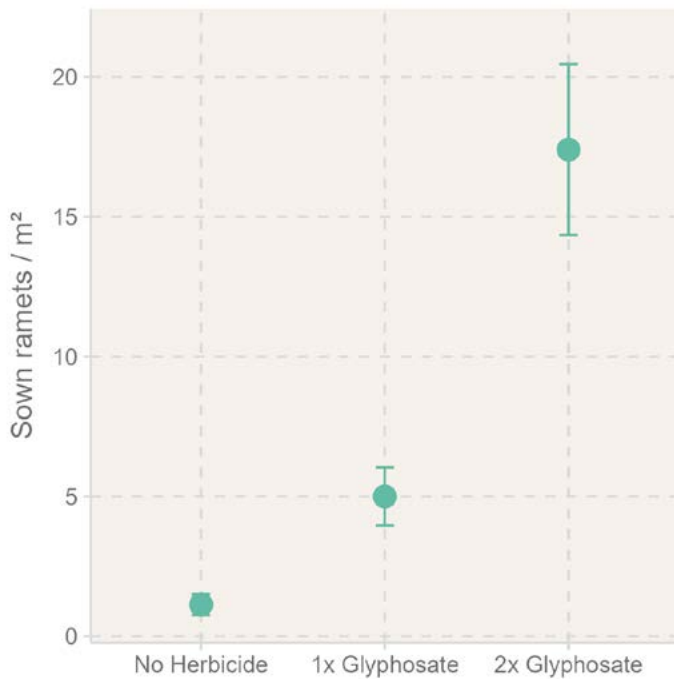


Figure 9. Seedling emergence (sown seedling density after one growing season) after herbicide treatments and native seeding.

We found that intense site preparation (herbicide frequency) is needed to establish prairie into cool season grass. Compared to no herbicide control plots, plots sprayed once with glyphosate reduced perennial weed cover (mostly cool season grass) by approximately 2x, and resulted in about 5 native plants/m². In plots sprayed twice, perennial weed cover decreased by nearly 8x, and produced over 15 individuals/m² (Fig. 9). Typically, seedlings resulting in native plant density > 10 individuals/m² during initial establishment can be considered likely to succeed, while plantings of lesser density represent establishment failures. In our study, only the plots sprayed twice produced stands likely to succeed.

Pro equivalent) and measured relative cover of all species and seedling emergence of sown native species. We also compared two seed mix designs that differed in grass species diversity, but it is too early to detect these effects.

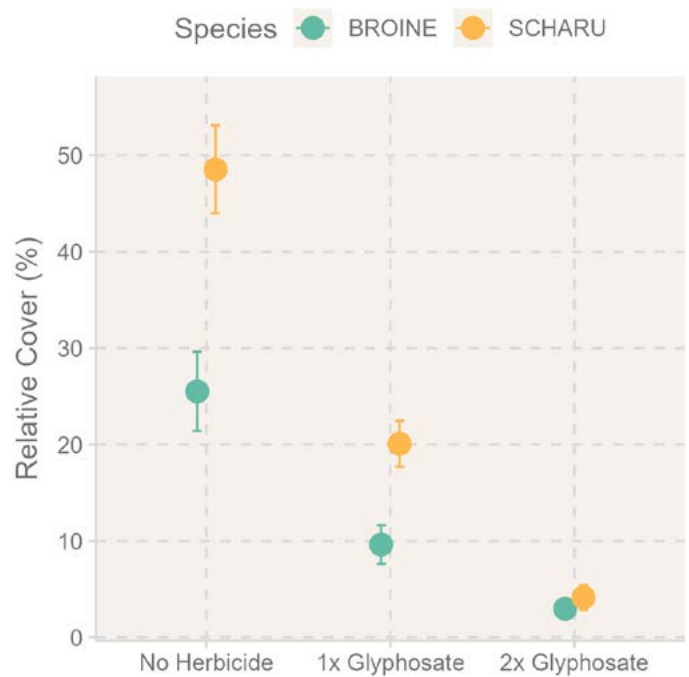


Figure 10. Relative cover of introduced cool season grasses after herbicide treatments and native seeding

For the most problematic introduced cool season grasses, we observed large decreases in cover as site prep herbicide frequency increased. Tall fescue and smooth brome completely dominated the control plots, making up almost 80% of the live cover. With one application of herbicide, combined cover of these grasses dropped to 30%, and with two applications of herbicide, dropped to 7% (Fig. 10) While it seems clear these grasses will rebound quickly in 1x sprayed plots, there may be sufficient native establishment to prevent re-established cool season grass dominance in the 2x sprayed plots.

MANAGEMENT IMPLICATIONS

Irvine Prairie continues to establish and progress well. Current site-preparation, seeding, and establishment management activities have resulted in success, but we have identified some new seeding methods that are likely to improve our future work. Because dormant broadcasting produced a more initially functional plant community while providing sufficiently high stem density, we plan on adopting the technique for future seedings.

Converting areas with perennial grass will require significant site prep using herbicide. Our experimental results show that any cool season grass stands will require at least two applications of glyphosate before sowing with native seeds. One early/mid growing season application followed by another late season application seems likely to succeed in grass waterways. Heavy brome or reed canary grass infestations on some fencelines and ditches will still likely require up to two full seasons of multiple herbicide applications.

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