

How well are native pollinator habitat programs working?

A case study from Iowa

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The Tallgrass Prairie Center empowers people to value and restore resilient, diverse tallgrass prairie

Programs

- Research and Restoration
 - Furthering our understanding of prairie restoration
- Natural Selections
 - Native plant materials development
- Iowa Roadside Management
 - Incorporating prairies into Iowa roadsides
- Prairie on Farms
 - Integrating prairie and agriculture



Tallgrass Prairie Center: Research & Restoration Program

Research Approach

Use combination of formal experiments, demo sites, and observational studies to answer applied questions

- Field experiments provide hard data to answer questions in detail
- Demo sites expand the concept, give opportunities for more comparisons, teaching

Use real world equipment and techniques

- Research implemented at relevant scales using relevant equipment (tractor mounted seed drills, mowers)
- Makes results directly applicable to other practitioners



Conservation programs for specific ecosystem services

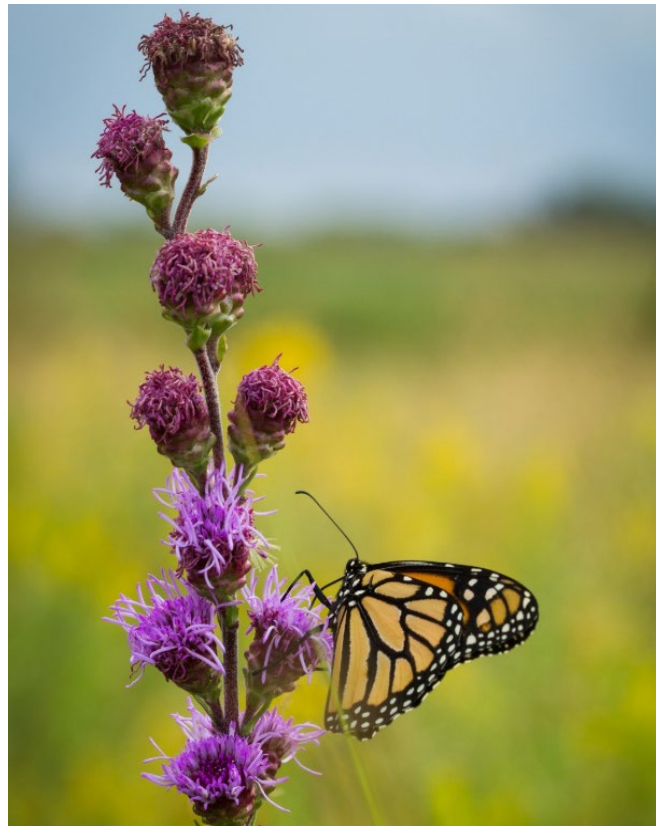
Emerging role of large ag conservation programs

Large conservation programs operating in ag landscapes strive to deliver services efficiently

- Conservation Reserve Program (CRP)
 - Targeted practices for specialized services
 - Erosion control, game bird habitat, historically
 - Utilize vast USDA infrastructure to operate at scale
 - Use revegetation as main tool

New role to address larger, more complex conservation issues

- More ecosystem rehabilitation activity
 - Rare/ declining habitat restoration
 - Pollinator and monarch recovery



Requirements for a successful program

As complexity of ecological goals increases, more prerequisites for achieving success

Traditional prerequisites for success

- Landowner adoption/program enrollment
- Planted acres

Ecosystem restoration prerequisites for success

- Dependable native seed supply and price
- Ecologically sound seed mix and management specifications
- Reliability in implementing specifications

Trends in uncertain conservation funding necessitate increase efficiency as well

Are the large ag conservation programs able to deliver intended ecosystem services efficiently and effectively?



How well do these large programs work?

Pollinator Habitat Initiative (CP-42) Case Study

Pollinator Habitat Initiative (CP-42)

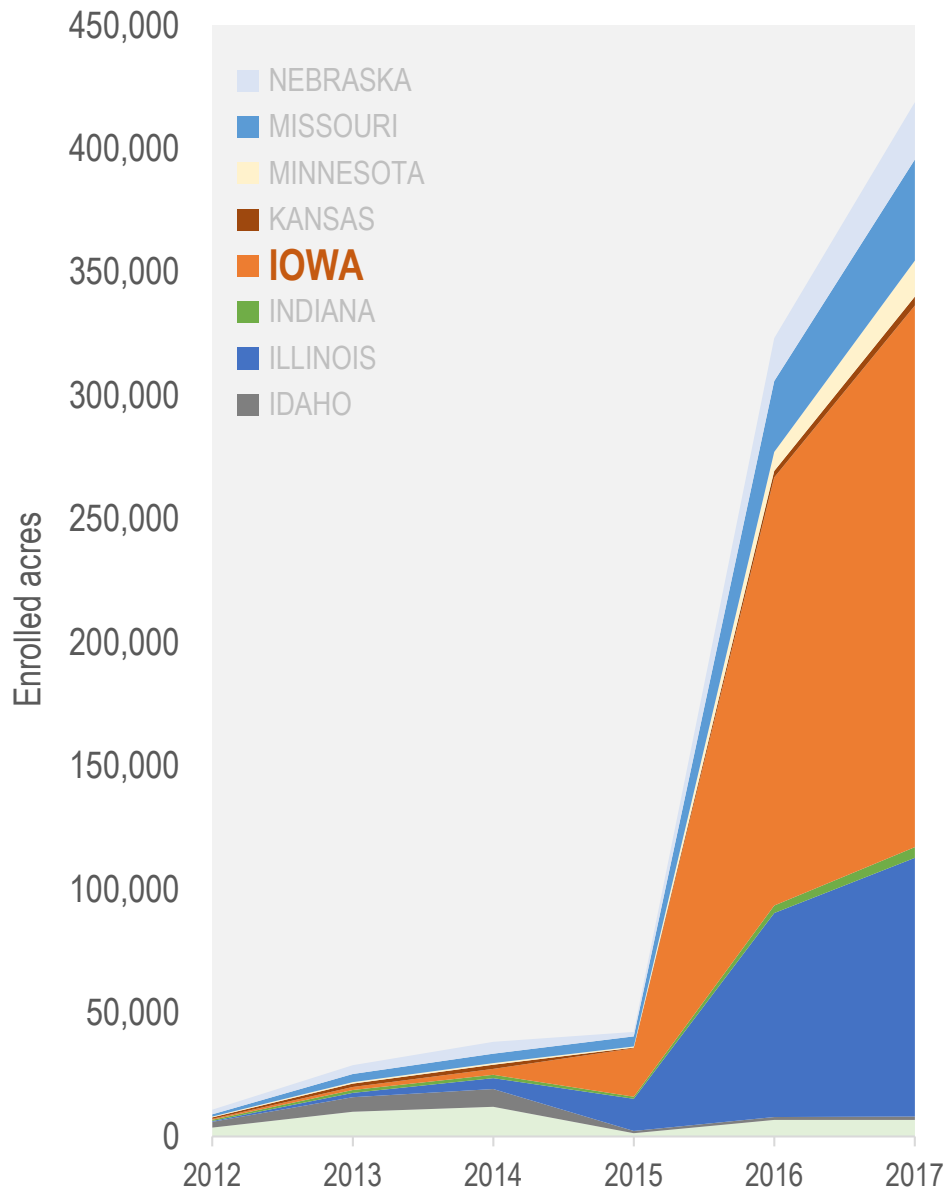
- Practice to improve pollinator habitat
- Initiated 2014, capped 2017/18
- “...create longer-lasting meadows of high-quality native wildflowers that support pollinators and other wildlife...”

By some metrics a massive success

- Farmer adoption high
- > 200,000 acres planted in IA alone

Was it efficiently implemented?

What were the ecological outcomes?



Pollinator Habitat Initiative (CP-42) Case Study

Defining Success Ecologically

CP-42 stands should: 1) ...contain a minimum of 9 species of pollinator-friendly flowering plants, including wildflowers, legumes, and/or shrubs and 2) at least 3 species shall have their primary onset of blooming during each period of April-June 15, June 15-July, and August-October.

Seed mix specifications as primary means to direct success

- Established idea in ecological restoration
- If you build it they will come
- Guidelines on seed mixes translate to vegetation and the wildlife using it

Success = floral resources for variety of pollinators all year long

- 9 wildflower species (diversity)
- 3 species flowering in spring, summer, fall (availability)
- 430 seeds/m², 75% forbs by density

Pollinator Habitat Initiative (CP-42) Case Study

Why Iowa?

High practice adoption in IA

- Many acres in IA
 - State with most CP-42 acres (218,482)
 - 8 of the top 10 counties for CP-42 acres are in IA

Highly developed seed market in IA

- Many key Midwest native seed retailers located in IA or nearby

Iowa set up for success

2020 Rank	State	County	Acres
1	Iowa	Ringgold	10,415
2	Iowa	Taylor	10,244
3	Missouri	Carroll	7,543
4	Illinois	Mason	7,188
5	Iowa	Black Hawk	7,095
6	Iowa	Howard	6,963
7	Iowa	Clay	6,617
8	Illinois	Vermilion	6,403
9	Iowa	Kossuth	6,311
10	Missouri	Harrison	6,243

Pollinator Habitat Initiative (CP-42) Case Study

Research Framework

Examine the execution of the CP-42 practice in IA, assess ecological and implementation outcomes.

Two focus areas:

1. Assess seed mixes over the course of the program
2. Evaluate success of CP-42 pollinator plantings



Assess seed mixes of CP-42 pollinator plantings

Methods

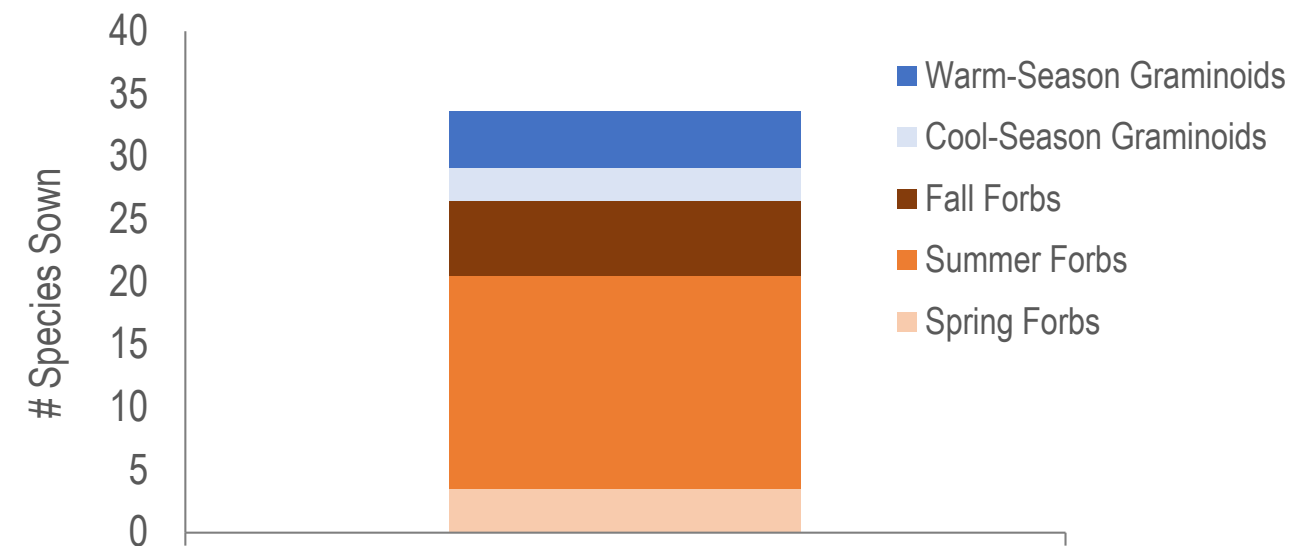
Assess seed mix composition and change in response to the program and market

- Seed mix sample from IA landowners enrolled in program
- Of 800 requests, procured 81 seed mixes with establishment information
- Data transformation to standardize seed mix information



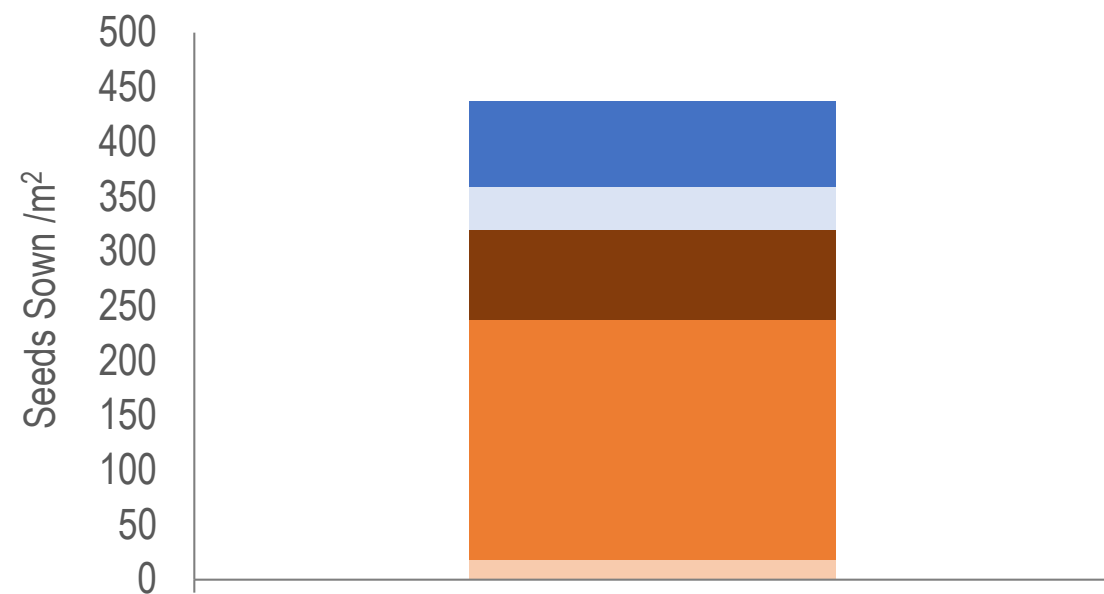
Native seed mixes during CP-42

The average pollinator seed mix (n=81)



Species diversity higher than min specs

- Most spp summer forbs
- 3-5 spp for other functional groups



Seeds sown around min specs

- Mostly summer forbs
- Very few spring seeds sown

Assess seed mixes of CP-42 pollinator plantings

The average pollinator seed mix (n=81)

Scientific Name	Common Name	% presence	% of seeds
<i>Rudbeckia hirta</i>	blackeyed Susan	98.8	9.3
<i>Schizachyrium scoparium</i>	little bluestem	95.1	9.3
<i>Bouteloua curtipendula</i>	sideoats grama	92.6	2.8
<i>Dalea purpurea</i>	purple prairie clover	92.6	4.6
<i>Monarda fistulosa</i>	wild bergamot	90.1	6.1
<i>Koeleria macrantha</i>	prairie Junegrass	88.9	3.7
<i>Chamaecrista fasciculata</i>	partridge pea	85.2	0.5
<i>Zizia aurea</i>	golden zizia	85.2	0.4
<i>Drymocallis arguta</i>	tall cinquefoil	80.2	4.5
<i>Heliopsis helianthoides</i>	smooth oxeye	79.0	0.8
<i>Oenothera biennis</i>	evening primrose	77.8	3.1
<i>Desmanthus illinoensis</i>	Illinois bundleflower	76.5	1.3
<i>Ratibida pinnata</i>	prairie coneflower	74.1	3.7
<i>Asclepias syriaca</i>	common milkweed	72.8	0.2

Some species planted at many sites at high rates

- Black-eyed susan, little bluestem, purple prairie clover

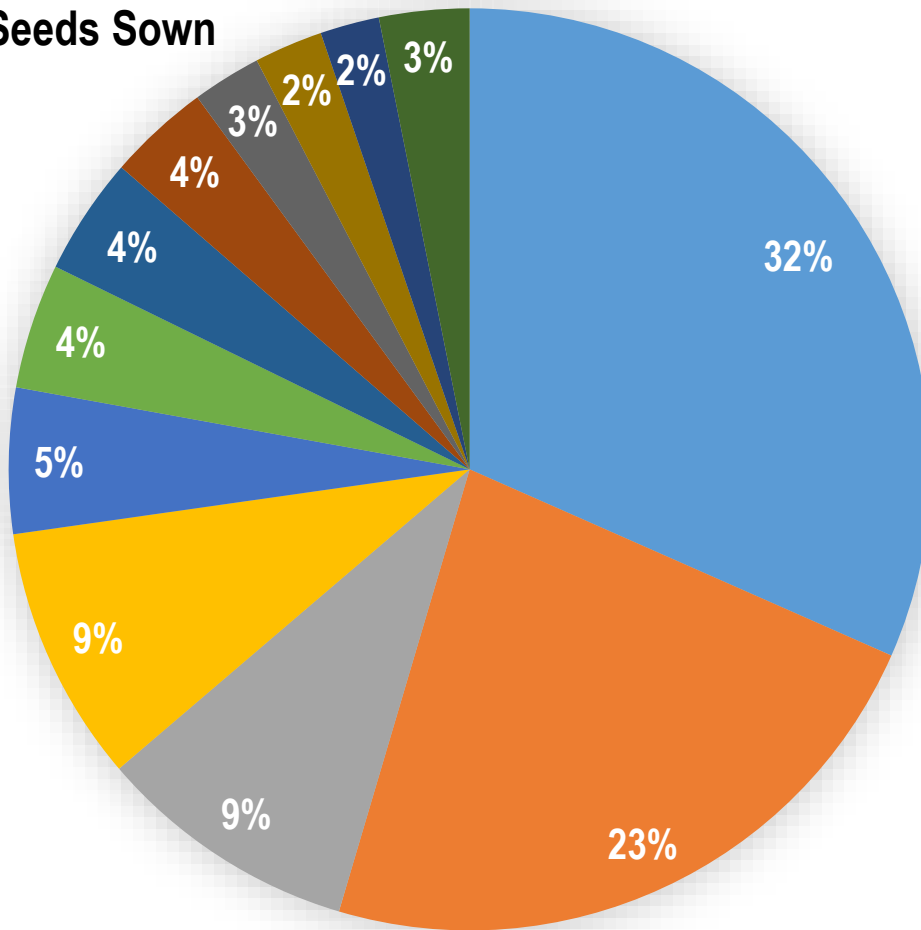
Others commonly planted, but at low rates

- Golden alexander, common milkweed, smooth oxeye

Assess seed mixes of CP-42 pollinator plantings

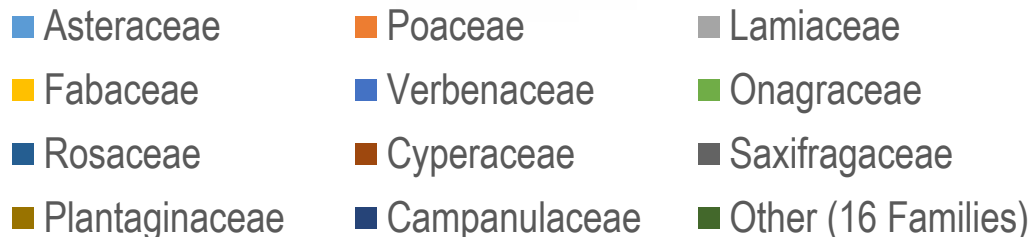
The average pollinator seed mix (n=81)

Total Seeds Sown



Across the board many taxa sown, but a few families most abundantly sown

- Asters (Asteraceae) and grasses (Poaceae) by far most sown
- Mints (Lamiaceae) and Legumes (Fabaceae) well represented



Assess seed mixes of CP-42 pollinator plantings

The average pollinator seed mix (n=81)

Timing of seeding	% of sites
February (Dormant-Frost)	2.5%
March (Dormant-Frost)	1.2%
April (Growing Season-Spring)	11.1%
May (Growing Season-Spring)	40.7%
June (Growing Season-Summer)	32.1%
July (Growing Season-Summer)	1.2%
November (Dormant-Fall)	7.4%
December (Dormant-Fall)	3.7%

Vast majority seeded late spring/early summer

- >70% Seeded May or June
- Very few dormant seedings, despite best practice

Vast majority conducted establishment mowing

- Recommended mowing well adopted by program participants

Times mowed	% of sites
0	2.5%
1-2	42.2%
3-4	40.9%
> 4	12%

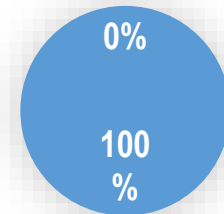
Assess seed mixes of CP-42 pollinator plantings

Did seed mixes meet criteria for success?

Floral Resource Diversity

9 wildflower species present

- Easy objective, all mixes met requirements

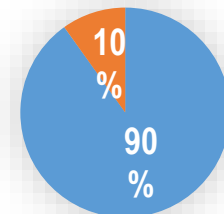


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Floral Resource Availability

3 species flowering in each of spring, summer, fall

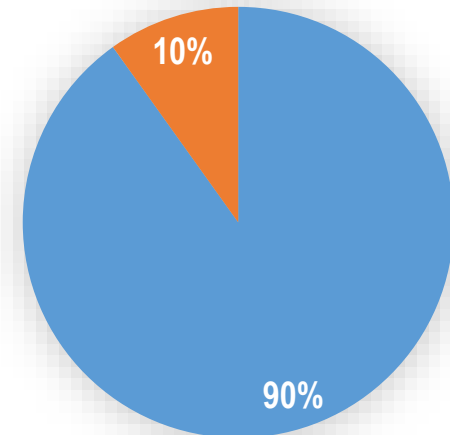
- Some mixes by specific vendor lacked enough spring flowering species



■ Pass ■ Fail

Overall Success Rate

- Vast majority (90%) met requirements, a few mixes ensured failure from the get-go



■ Pass ■ Fail

(n=81)

Assess seed mixes of CP-42 pollinator plantings

Results Recap

- **Seed mixes relatively diverse, but most seeds sown were core set of summer wildflowers**
- **Most mixes seeded in May and June, and mowed 1-4 times during initial establishment**
- **Nearly all seed mixes met criteria for floral diversity and floral availability**



Evaluating success of CP-42 pollinator plantings

Objectives

1. Characterize overall vegetation outcomes on IA CP-42 plantings
2. Compare seed mixes planted to established stands
3. Assess whether plantings meet criteria for success



Evaluating success of CP-42 pollinator plantings

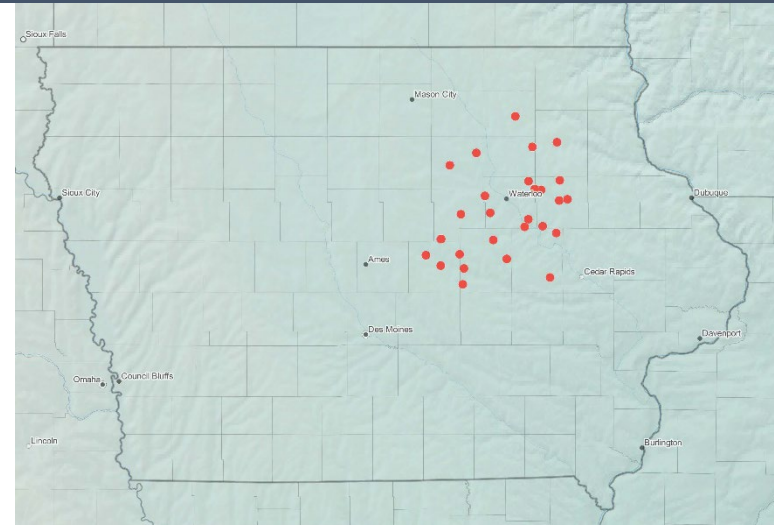
Methods

Vegetation surveys

- Randomly chosen 46 sites in 10 E IA counties
- Seed mixes obtained through farmer surveys
- Restricted random sampling pool to only sites with an actual seed mix (not NRCS seed plan)

Data collected 2018-2019

- Forb density (stems and plants)
- >20cm tall (no seedlings sampled)
- 3 yr old plantings (NRCS criteria for “established”)



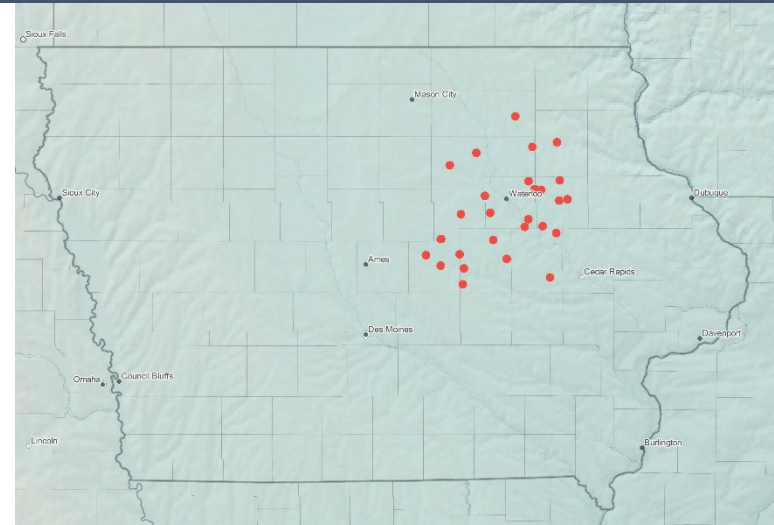
Evaluating success of CP-42 pollinator plantings

Methods

Comparison metrics

- Stand composition
 - Broadleaf species only
- Establishment
 - Stems per seeds sown
- Cost effectiveness
 - Stems per dollar

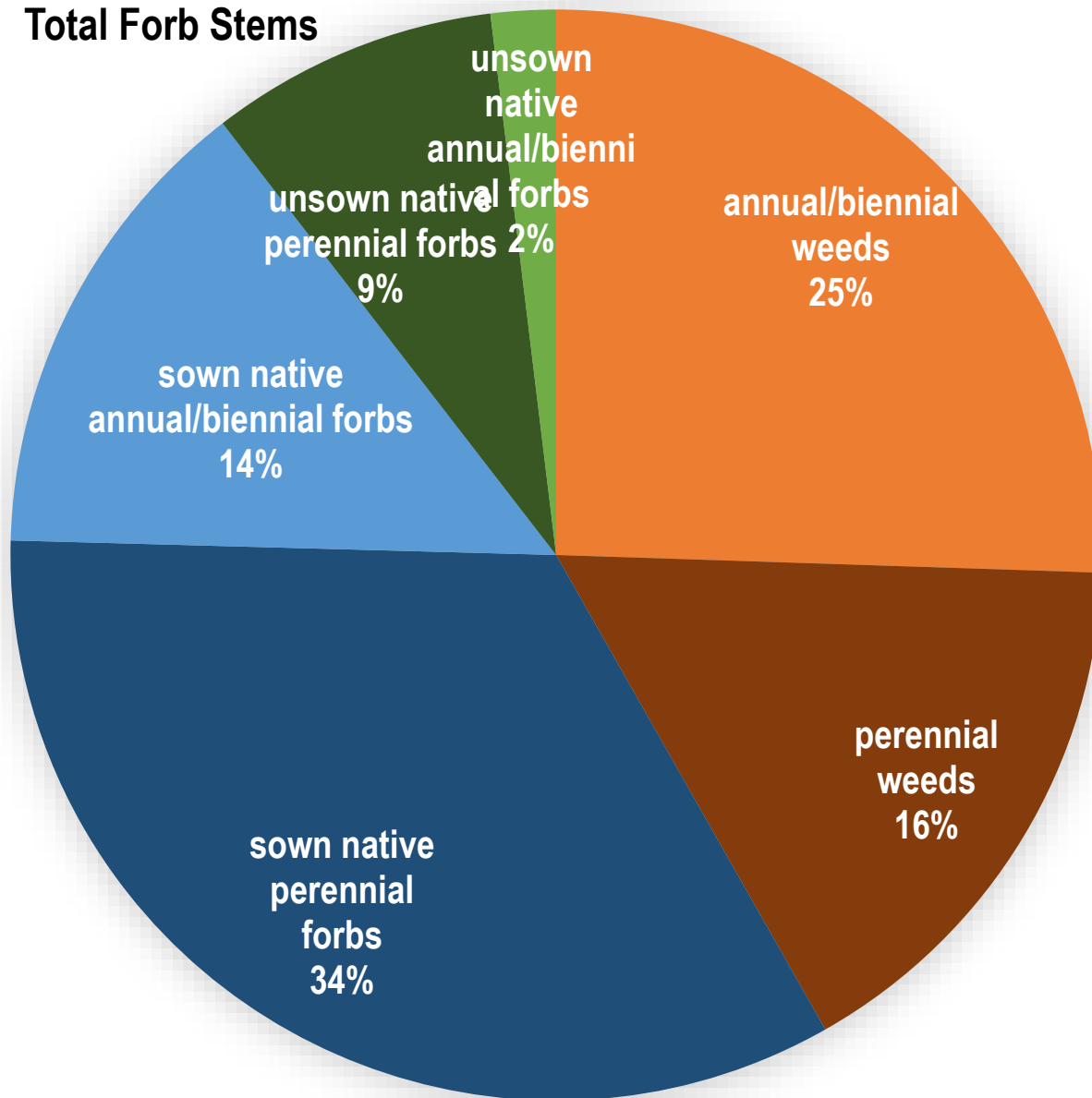
Seed mixes of sites assessed resembled the “average” seed mix



Evaluating success of CP-42 pollinator plantings

The average pollinator habitat planting (forbs only) (n=46)

Total Forb Stems



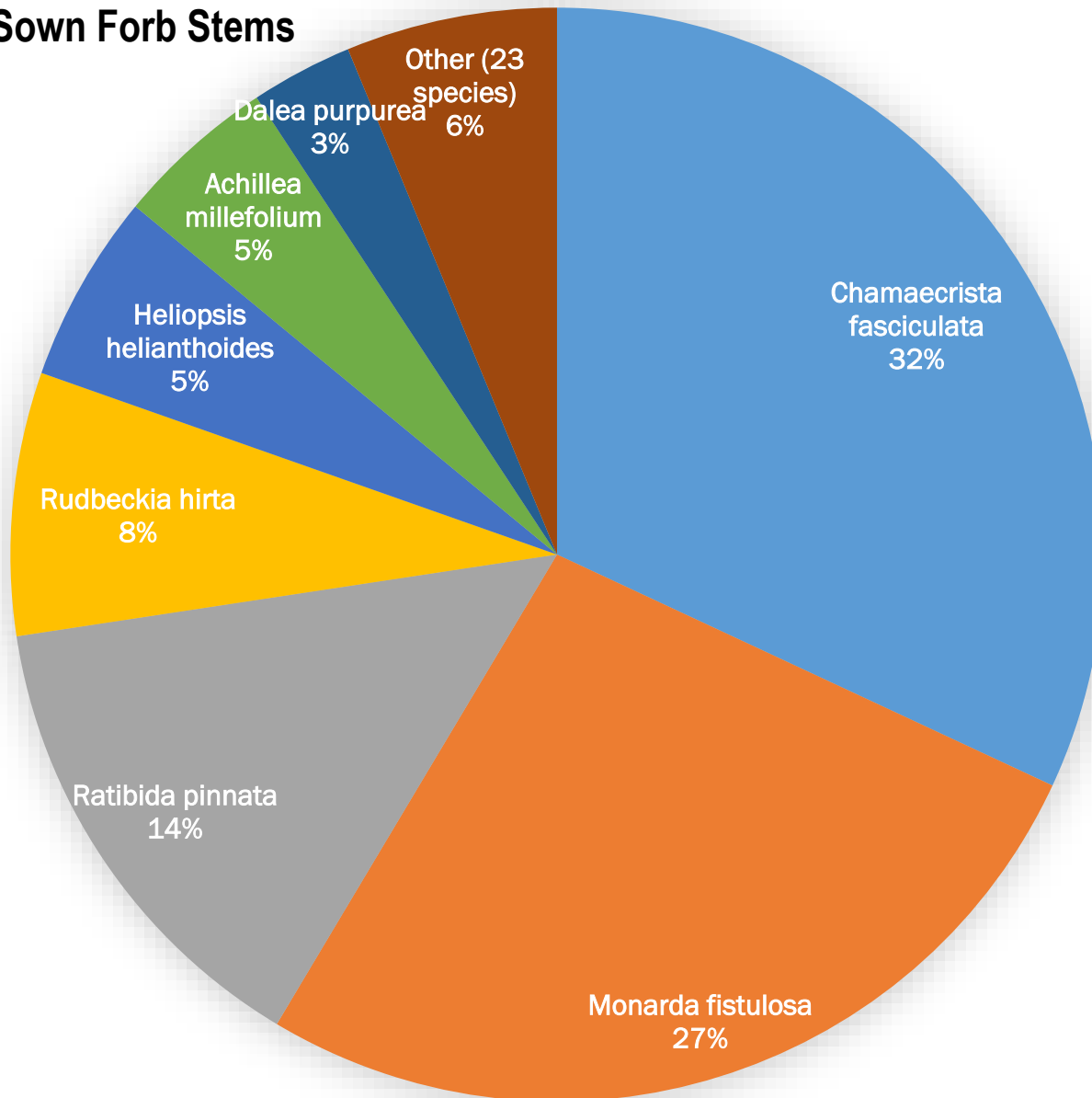
Average stand about half weed stems (41%), half sown forbs (47%), rest (12%) unsown native forbs

- Perennial weeds mostly dandelion, Canada thistle, alfalfa
- Annual/biennial weeds mostly mare's tail, giant ragweed, wild carrot, lamb's quarters
- Unsown native forbs mostly Canada goldenrod, frost aster

Evaluating success of CP-42 pollinator plantings

The average pollinator habitat planting (forbs only) (n=46)

Sown Forb Stems



On average, 12 forb species present

Handful of species made up vast majority of stands

- Partridge pea, beebalm, yellow coneflower

Evaluating success of CP-42 pollinator plantings

The average pollinator habitat planting (forbs only) (n=46)

Common name	Scientific Name	Establishment (stems/seeds sown)
<i>Selected best establishers (within top 10)</i>		
partridge pea	<i>Chamaecrista fasciculata</i>	412.1%
showy ticktrefoil	<i>Desmodium canadense</i>	74.7%
butterfly milkweed	<i>Asclepias tuberosa</i>	45.2%
smooth oxeye	<i>Heliopsis helianthoides</i>	40.0%
wild bergamot	<i>Monarda fistulosa</i>	25.9%
common milkweed	<i>Asclepias syriaca</i>	18.8%
<i>Selected worst establishers (within bottom 10)</i>		
arrowhead rattlebox	<i>Crotalaria sagittalis</i>	0.2%
alumroot	<i>Heuchera richardsonii</i>	0.1%

Huge variation in species establishment

- Some strongly growing populations (more stems than seeds planted)
- Most species had comparatively low establishment
- Some species near zero establishment

Evaluating success of CP-42 pollinator plantings

The average pollinator habitat planting (forbs only) (n=46)

Common name	Scientific Name	Stems produced per \$1 of seed
Selected most cost effective (within top 10)		
partridge pea	<i>Chamaecrista fasciculata</i>	15187
blackeyed Susan	<i>Rudbeckia hirta</i>	3043
wild bergamot	<i>Monarda fistulosa</i>	2567
showy ticktrefoil	<i>Desmodium canadense</i>	1249
smooth blue aster	<i>Symphotrichum laeve</i>	777
Selected least cost effective (within bottom 10)		
bluejacket	<i>Tradescantia ohiensis</i>	5
compassplant	<i>Silphium laciniatum</i>	3
arrowhead rattlebox	<i>Crotalaria sagittalis</i>	1
tall thoroughwort	<i>Eupatorium altissimum</i>	1
Virginia mountainmint	<i>Pycnanthemum virginianum</i>	<1

Huge variation in cost effectiveness

- High = cheap, high establishment spp
- Low = expensive, low establishment spp or extremely expensive /poorly establishing spp
- Rarely planted but highly cost effective species - low hanging fruit

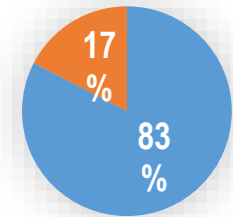
Evaluating success of CP-42 pollinator plantings

Did plantings meet criteria for success?

Floral Resource Diversity

9 wildflower species present

- Most sites met requirements (avg. 12 spp)



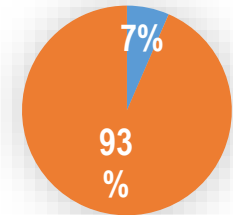
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Floral Resource Availability

3 species flowering in each of spring, summer, fall*

- Only 3 sites met the success criteria

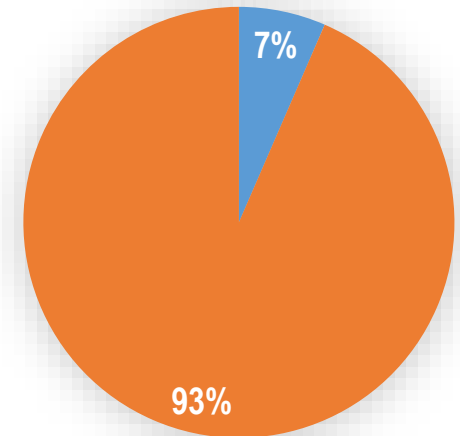
**Species presence as potential for flowering*



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Overall Success Rate

- Vast majority (93%) **failed to meet** criteria for success

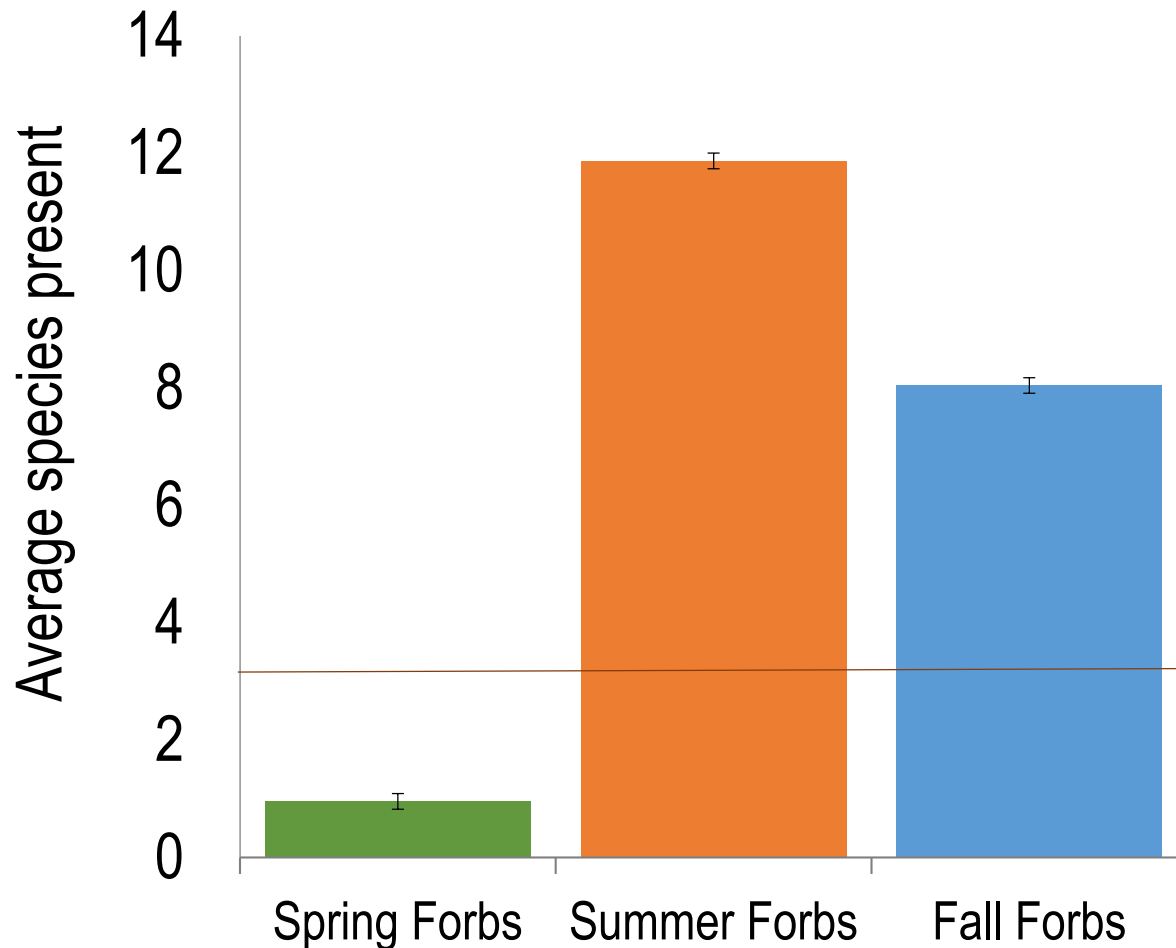


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(n=46)

Evaluating success of CP-42 pollinator plantings

Why did plantings fail to provide floral resource availability?



Overall lack of spring flowering forbs

- On average, barely 1 spring forb at each site
- Only 63% of sites had *any* spring forbs present

Evaluating success of CP-42 pollinator plantings

A closer look at spring forb establishment

Common Name	Scientific Name	% sites sown	Stems produced per \$1 of seed
meadow garlic	<i>Allium canadense</i>	57%	15.5
red columbine	<i>Aquilegia canadensis</i>	70%	14.6
alumroot	<i>Heuchera richardsonii</i>	52%	8.5
foxglove beardtongue	<i>Penstemon digitalis</i>	17%	22.5
large beardtongue	<i>Penstemon grandiflorus</i>	17%	0.9
longbract spiderwort	<i>Tradescantia bracteata</i>	13%	71.8
bluejacket	<i>Tradescantia ohiensis</i>	26%	4.7
golden alexander	<i>Zizia aurea</i>	85%	54.2

No species redundancy in seed mixes

- Min # species always planted

Spring forbs more effort to establish

- All fairly low cost effectiveness (low establishment, high cost)

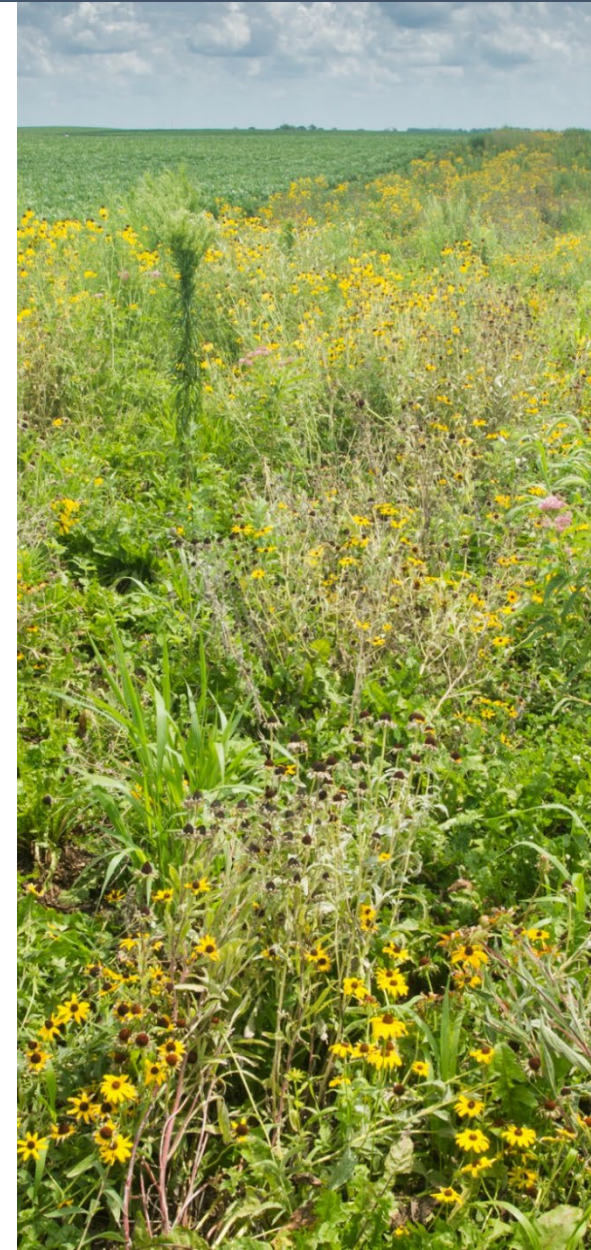
Improve success by seeding more spring forb species

- At least 2x more spp to expect 3 present
- More cost effective spp to increase available resources for more spp

Evaluating success of CP-42 pollinator plantings

Results Recap

- Only half of typical pollinator stands (forbs only) composed of sown wildflowers, weeds and ruderal natives make up other half
- Vast majority of stands failed to meet criteria for success due to lack of spring forbs present
- Utilize more cost effective species, especially spring forbs, to improve likelihood of success



Evaluating success of CP-42 pollinator plantings

What about the actual pollinators?

Native bees *are* using CP-42 native pollinator plantings

- ~70% of bees were collected from sown flowers
- Wild specialist bees used the plantings, mostly Asteraceae specialists
- Sown flower density correlated with density/species richness of bees

Wen, A., Elgersma, K., Sherrard, M. et al. 2021. Wild bee pollinators and their association with sown and unsown floral resources in reconstructed pollinator habitats within an agriculture landscape. Insect Conservation and Diversity. in review.





Overall Summary

Examine the execution of the CP-42 practice in IA, assess ecological and implementation outcomes.

1. Nearly all CP-42 seed mixes met criteria for success

1. Most seeds sown in mixes were from core set of summer wildflowers, though mixes were usually fairly diverse

2. CP-42 pollinator plantings rarely met criteria for success

1. About half of plantings resulted in sown forb dominated stands, and were dominated by only a few common summer wildflowers
2. Vast majority of stands failed to meet criteria for success due to lack of spring forbs present. Planting more spring species likely to improve success.

Conclusions

Room for improvement in large ag conservation programs

- Support research into mix design, planting practices, and seed production
- Require quantitative monitoring in practice rules
- Push adoption of dormant seeding



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