You plant it, they will come— Establishment of vegetation and native bee communities in the Conservation Reserve Program habitat

Ai Wen

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University of Northern Iowa

- Bee decline and drivers (habitat loss and chemical)
- CRP program overview and UNI involved research
- Research findings (Bee and floral community composition; bee-floral interaction; bumblebee population in landscape; chemical detection in CRP)
- Take home message: you plant it, they will come

Interaction Disruption

Climate change is affecting ranges globally. Here ants are invading and consuming wildlife in cloud forest never before exposed to these marauders.

Nitrification

Fertilizer and products of fossil fuels combustion are nitrifying the planet, challenging the biotas adapted to low-nutrient conditions.

Fin

Global warming elevates fire risk. Fires in Australia, Amazonia, and California burned an unprecedented >5 million hectares of forest in 2019.

Storm Intensity

Climate changes bring stronger, more frequent storms and hurricanes; more fire-igniting lightning; and damaging flooding.

Droughts

Arctic sea ice is declining precipitously, arctic-alpine

contracting, while sea level rise threatens coastal.

and other cold-adapted communities are

Global Warming

Periods with diminished precipitation are becoming longer, more frequent, and warmer, with grave consequences for all life.

DEATH BY A THOUSAND CUTS

GLOBAL THREATS TO INSECTS

Pollution

Chemical, light, and sound pollution of water, air, and soil are impacting plant and animal life worldwide.

Urbanization

Our global population of 7.8 billion, apread planet-wide, comes at great cost to biodiversity and wildlands. Aiready, over 500 vertebrates have been driven to extinction.

Introduced Species

Global trade is accelerating the movement of pernicious plants, animals, and pathogens to new regions-often with devastating consequences.

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Agricultural Intensification

Industrialized agriculture, with its attendant increases in scale, monoculturalization, nutrient input, and posticide use, is becoming increasingly nature unfriendly.

Deforestation

The tropics lost 11.9 million hectares of forest in 2019, mostly to agriculture.

Insecticides

Modern, industrialized agriculture, with its increasing reliance on chemical insecticides, has led to chronic contemination of wildlands and impacts to non-target insects.

"Death by a thousand cuts" —Many stressors act upon insects

Insect decline in the Anthropocene: Death by a thousand cuts

David L. Wagner^{a, 1}, Eliza M. Grames^a, Matthew L. Forister^b, May R. Berenbaum^c, and David Stopak^d

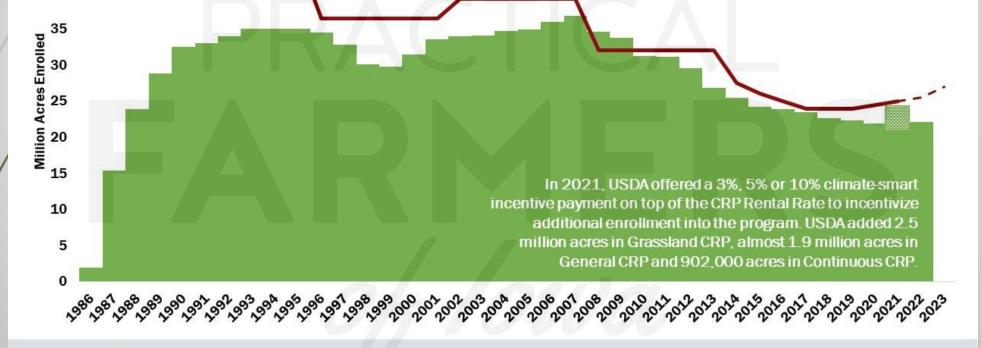
Nature is under siege. In the last 10,000 y the human population has grown from 1 million to 7.8 billion. Much of Earth's arable lands are already in agriculture (1), millions of acres of tropical forest are cleared each year (2, 3), atmospheric CO₂ levels are at their highest concentrations in more than 3 million y (4), and climates are erratically and steadily changing from pole to pole, triggering unprecedented droughts.

status of insects, the Entomological Society of America hosted a symposium at their Annual Meeting in St. Louis, Missouri, in November 2019. The Society was motivated to do so by the many inquiries about the validity of claims of rapid insect decline that had been received in the months preceding the annual meeting and by the many discussions taking place among members. The entomological community was in need



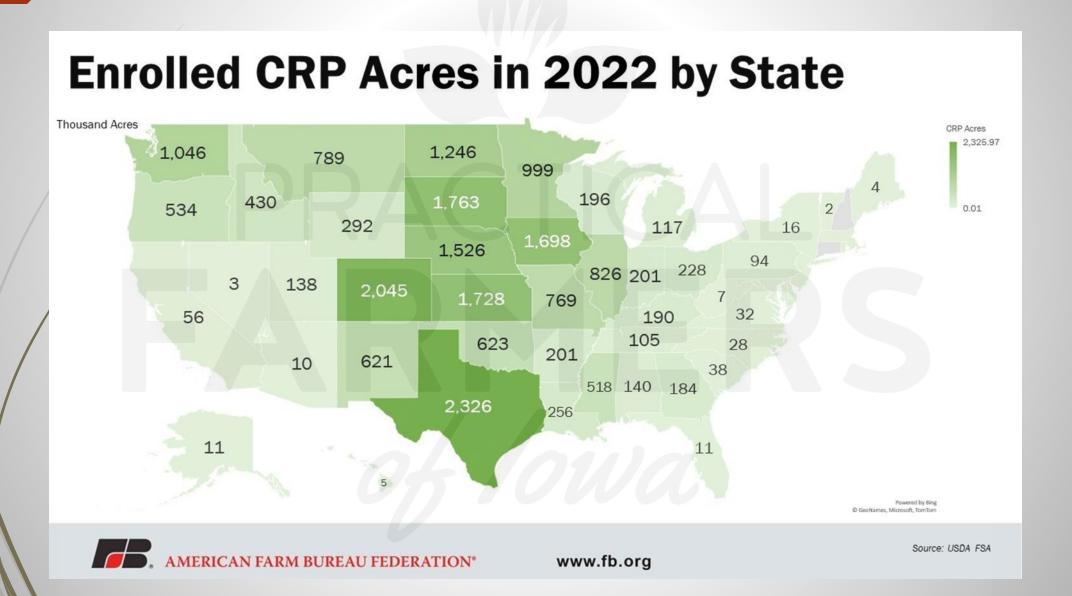
USDA Farm Service Agency-Conservation Reserve Program (CRP)

Enrolled CRP Acres through 2022 Congressional CRP Acreage Cap Set in Farm Bill Grows to 27 Million Acres in 2023



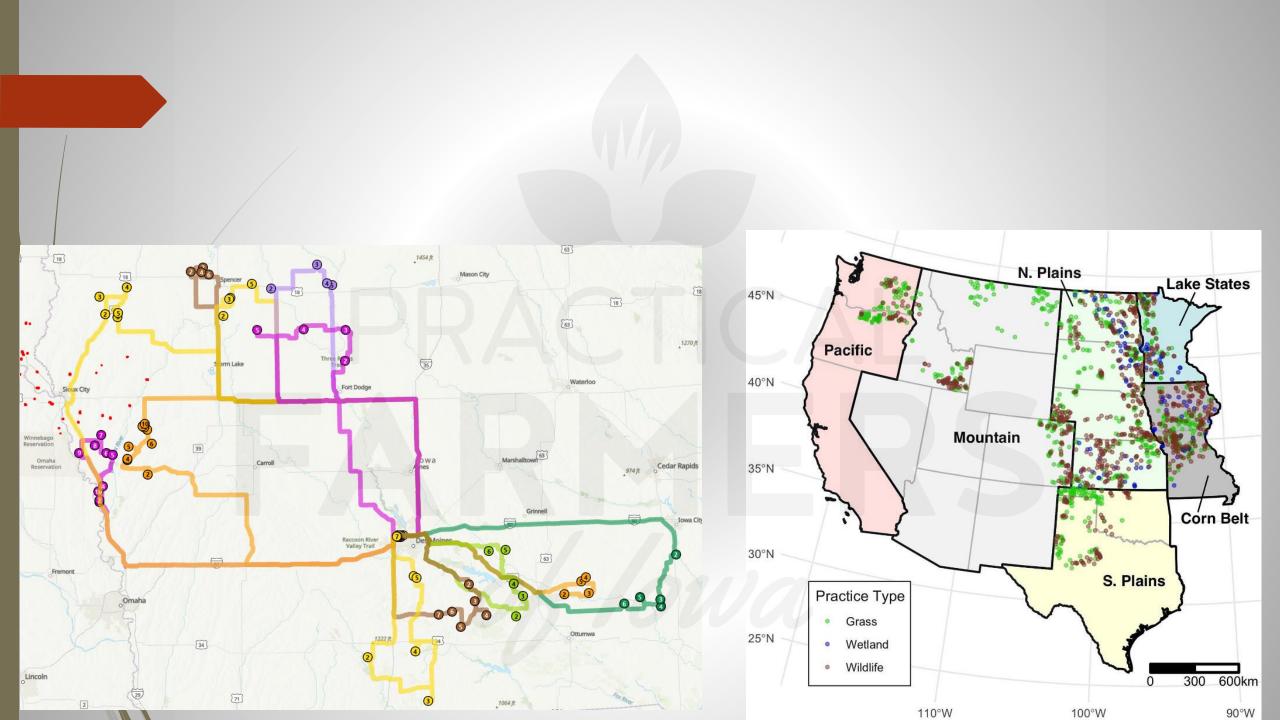
Source: USDA FSA

> Question: Are the constructed CRPs doing its job?

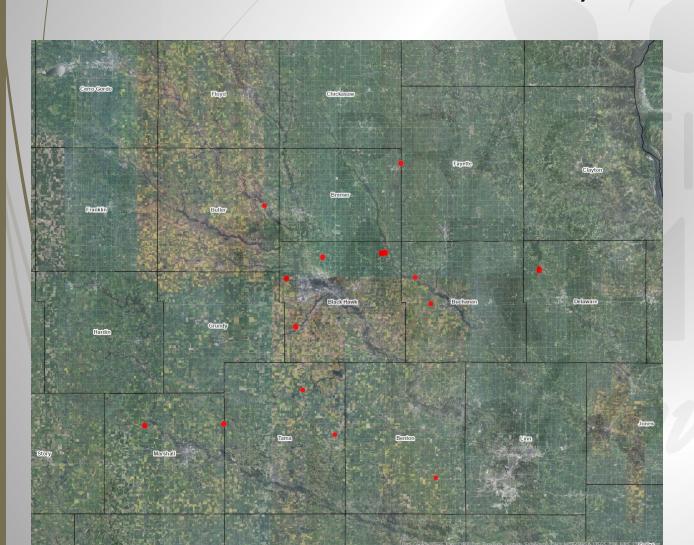


The effectiveness and the ecosystem functions of the Conservation Reserve Program across the central and western U.S.





- Question: What wild bees can be found three years after CRP planting?
- > Question: Do they like the plants we planted?



Since 2010, 160,000 ha of Pollinator Habitat Initiative CRP (CP-42) planted, about 42% of nationally established CP-42 acreages are in Iowa









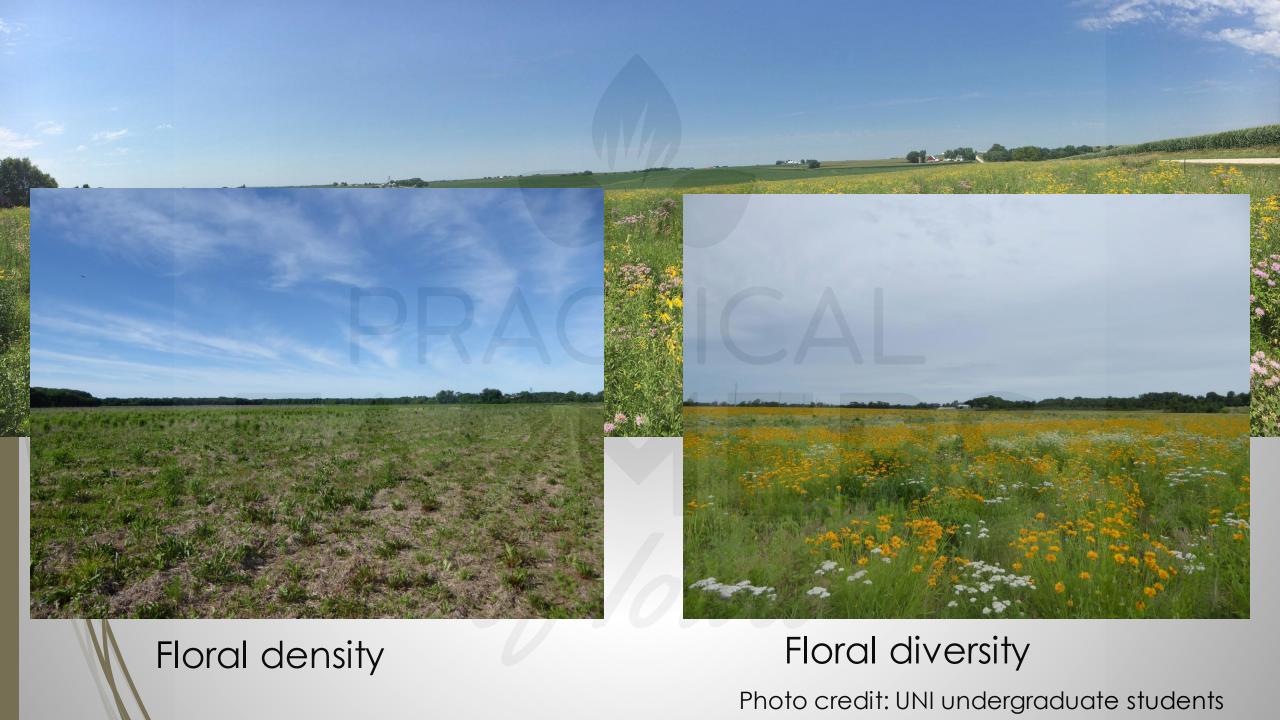


- > 19 CP-42 sites
- Vegetation survey (75 0.5mX2m quadrat/site)
- > All forb stem density
- > Sweep netting of bees
- (1 ha/1hr/site)

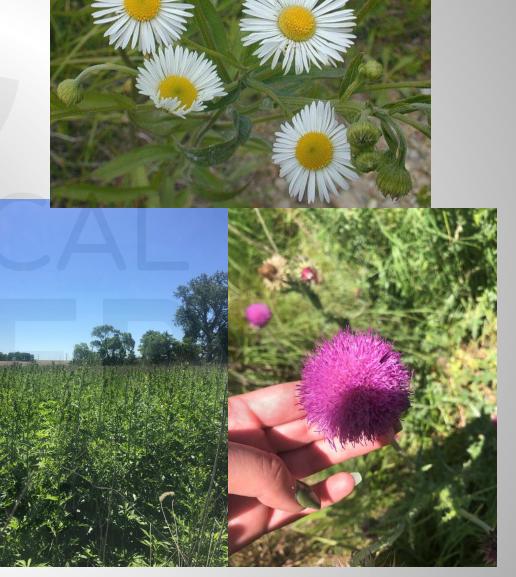












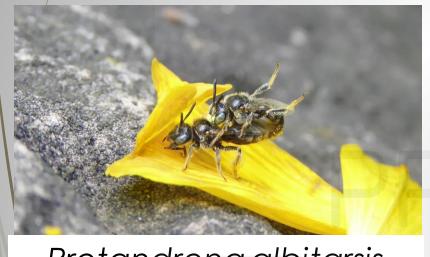
Unsown floral

> 620 specimens of 76 wild bee species

Collected from 37 floral sources

Specialist	Status	Floral source
Andrena chromotricha	Rare	Asteraceae
Andrena placata	Uncommon-Rare	Asteraceae
Andrena rudbeckiae	Uncommon-Rare	Asteraceae
	Accidentally	
Andrena wilkella	introduced from	
(introduced)	Europe	Fabaceae
, Dieunomia heteropoda	Uncommon-Rare	Asteraceae
Megachile latimanus		Asteraceae, Fabaceae
Melissodes desponsus	Uncommon	Asteraceae
Melissodes druriellus	Uncommon-Rare	Asteraceae
Melissodes subillatus	Rare	Asteraceae
Melissodes trinodis	Uncommon-Rare	Asteraceae
Pseudopanurgus		
albitarsis	Rare	Asteraceae
Pseudopanurgus		
rudbeckiae	Rare	Asteraceae
Svastra obliqua	Common-Uncommon	Asteraceae

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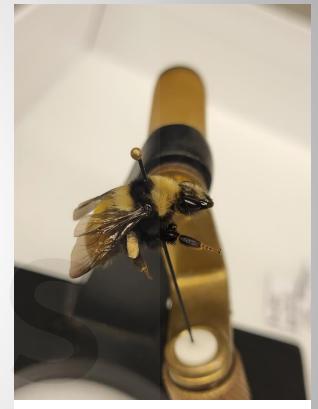


Protandrena albitarsis

Photo by Lopez-Uribe lab



Bombus rufocinctus



Bombus borealis



The most "bee friendly" sown flowers

	Bee	Bee
Plant Species (Sown)	density	richness
Monarda fistulosa	177	31
Chamaecrista fasciculata	60	19
Ratibida pinnata	51	9
Rudbeckia hirta	38	8
Heliopsis helianthoides	36	14
Echinacea purpurea	30	11
Achillea millefolium	24	9
Ratibida columnifera	9	4
Coreopsis lanceolata	6	3
Agastache foeniculum	4	3
Asclepias tuberosa	4	4
Dalea purpurea	4	4
Penstemon digitalis	4	4
Silphium perfoliatum	1	1
Verbena hastata	1	1

The most "bee friendly" sown flowers



Bee balm (177 bees)



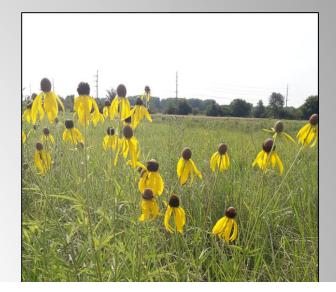
Black-eyed Susan (38 bees)



Partridge peas (60 bees)



Purple coneflower (36 bees)

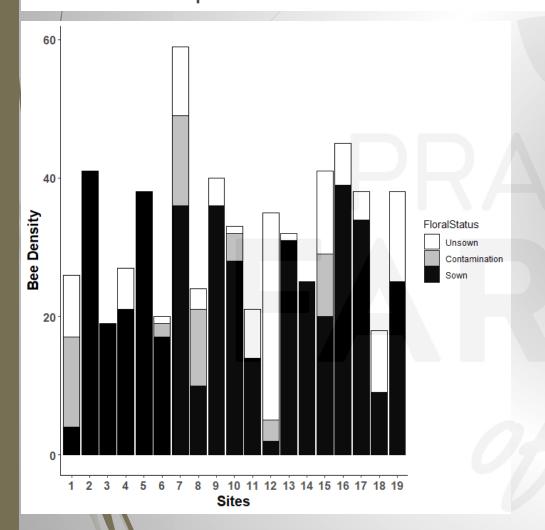


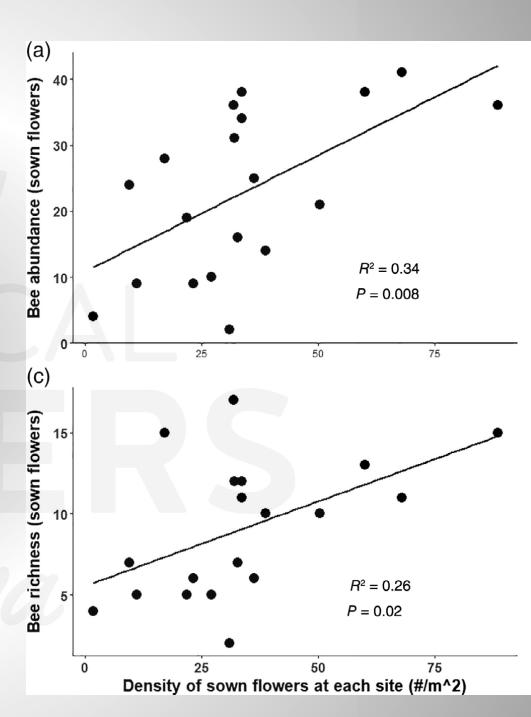
Gray headed coneflower (51 bees)



False sunflower (30 bees)

► More bees (both abundance and richness) visiting sown species than unsown species





The most "bee friendly" unsown flowers

Plant Species		
(Unsown)	Bee density	Bee richness
Securigera varia	27	4
Daucus carota	22	7
Cirsium arvense	21	15
Crepis tectorum	9	6
Cirsium vulgare	8	3
Trifolium repens	7	4
Lactuca serriola	5	2
Erigeron annuus	3	3
Trifolium pratense	3	3
Hypericum		
punctatum	2	2
Pastinaca sativa	2	1
Trifolium hybridum	2	2
Erigeron strigosus	1	1/
Hypericum		
pyramidatum	1	



Crown vetch (27 bees)



Queen Ann's lace (22 bees)



Canada thistle (21 bees)

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Hypericum		
punctatum	2	2
Pastinaca sativa	2	1
Trifolium hybridum	2	2
Erigeron strigosus	1	1
Hypericum		
pyramidatum	1	1

- Unsown floral have higher specialization indices
- More unsown flowers in the site increases the plant-pollinator network's modularity and nestedness



Bombus fervidus



Sphecodes davisii

Four years late Repeated visits in 2022-2023

Mowing and burning keeps maintain forb density

Preventing of woody establishment





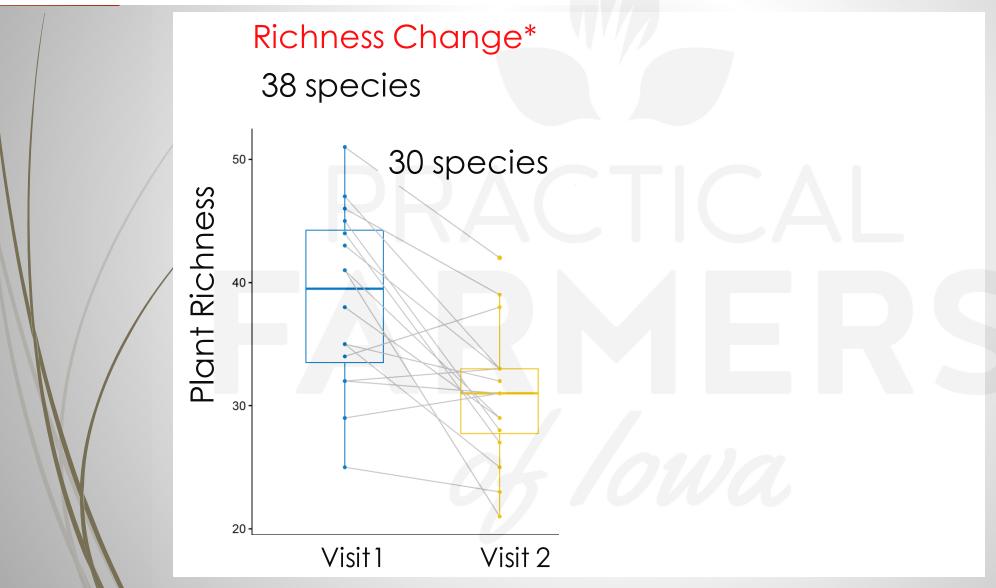
.....Four years later Repeated visits in 2022-2023

Native grass establishment keeps weed level down

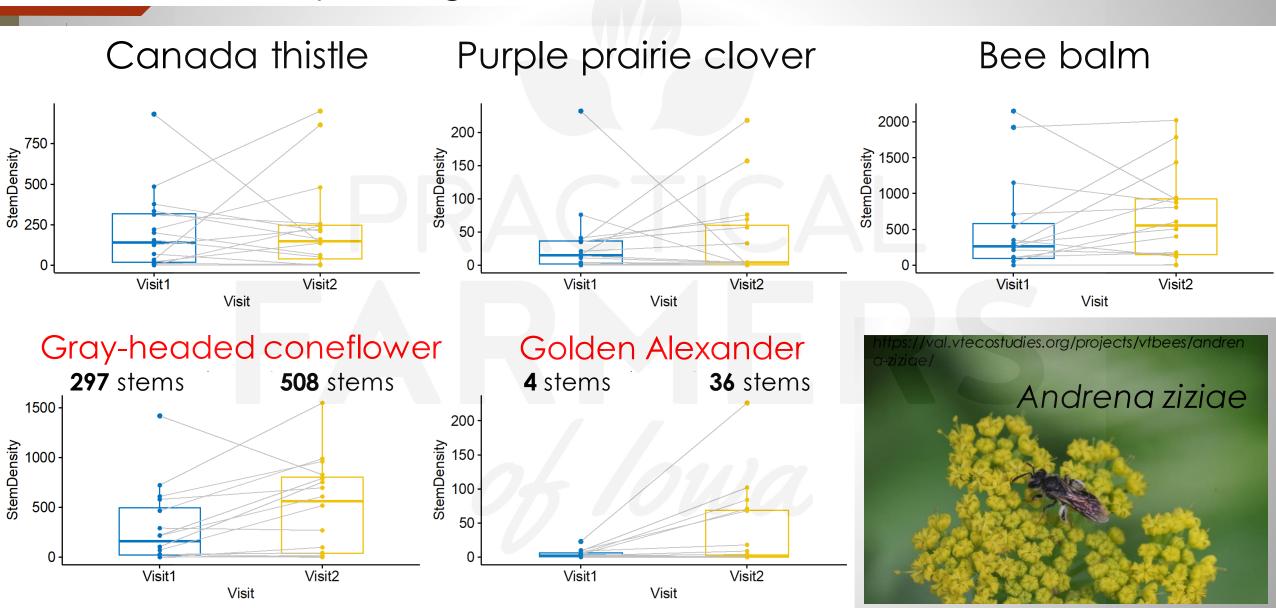




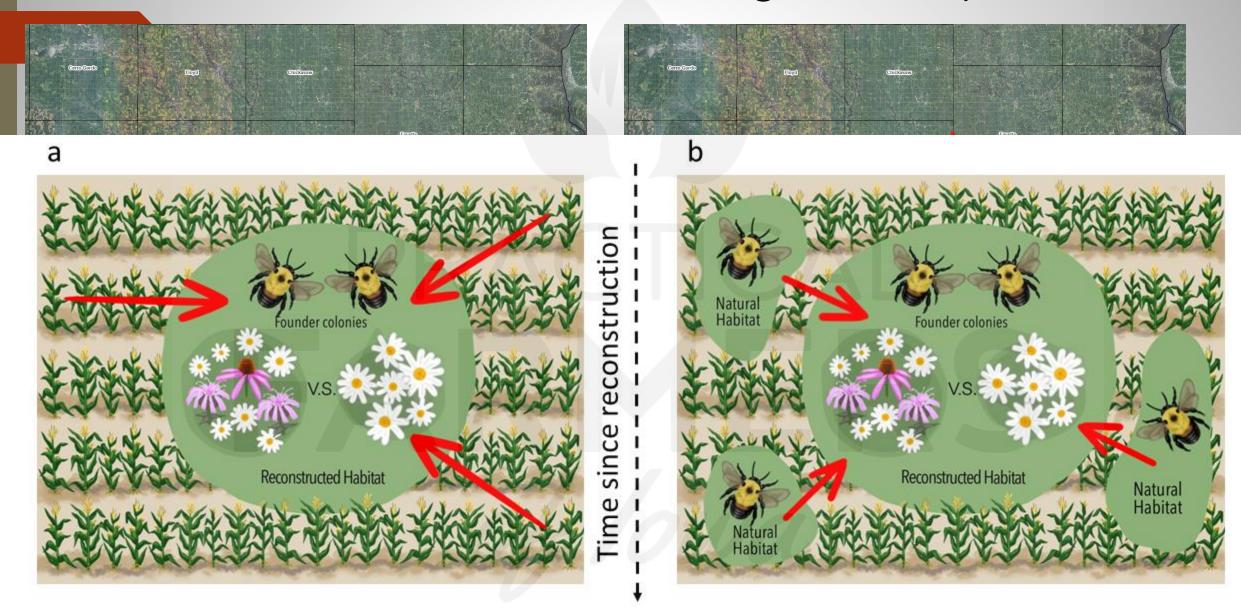
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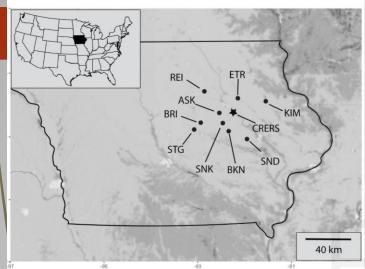


Plant stem density change

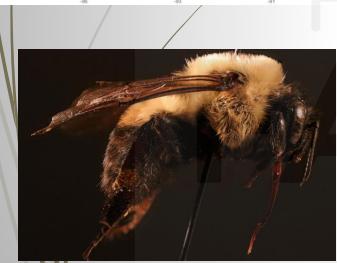


> Question: Are the bees all genetically related?





- 9 CRP sites and 1 reference site
- 5-23 B. griseocollis collected from each site
- Microsatellite method to measure the genetic structure of the bumblebee population at each site
- Landscape variables



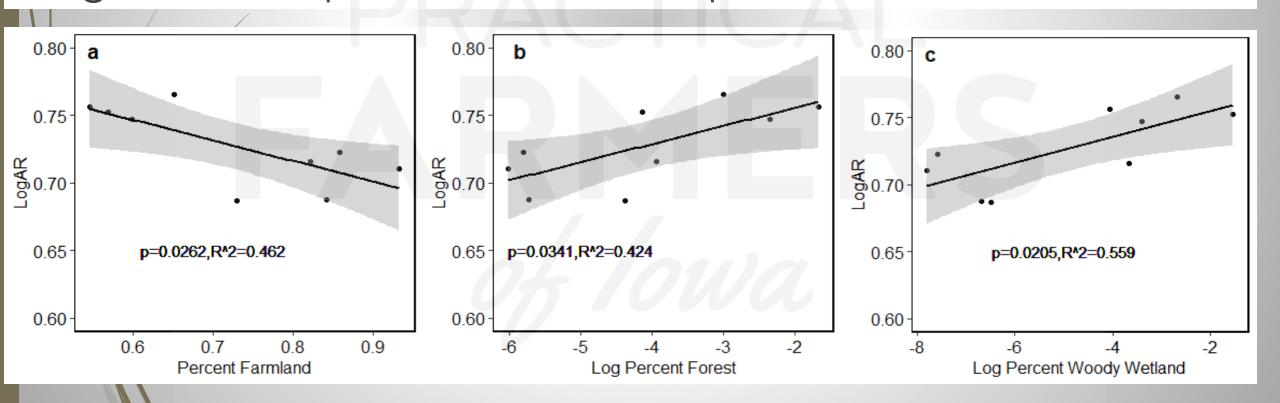
Bombus griseocollis (Brown-belted bumblebee)

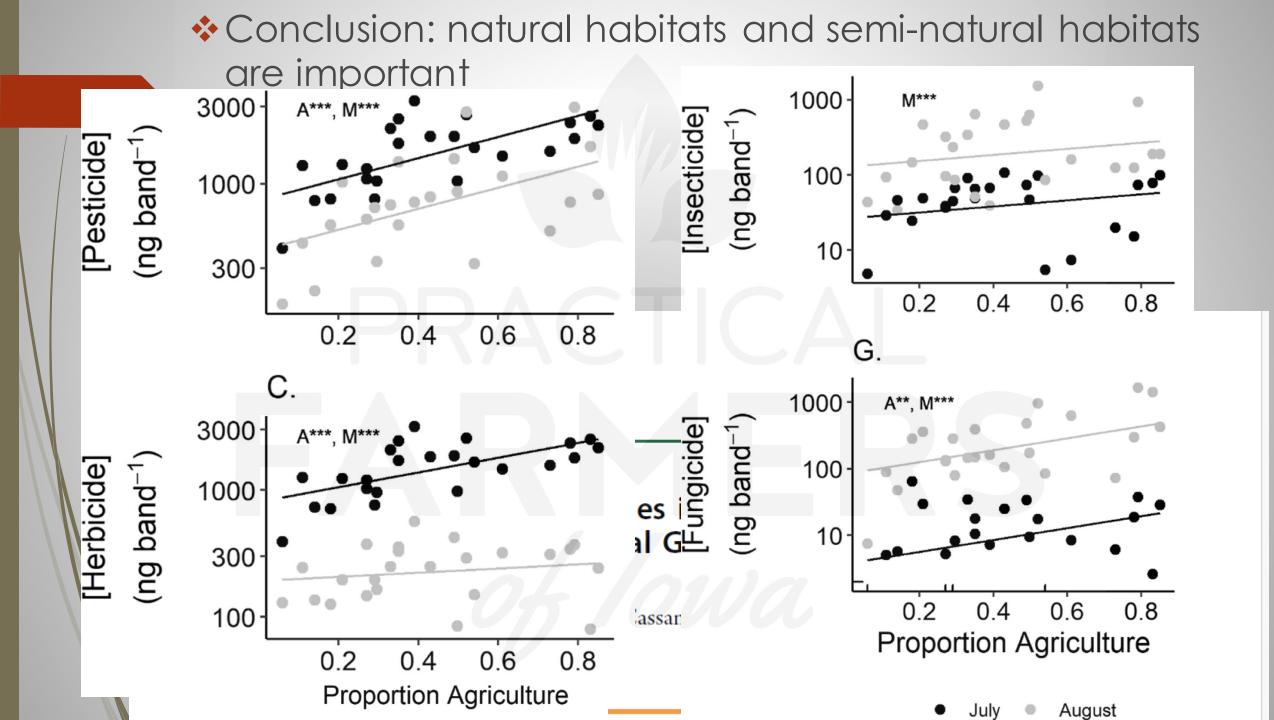






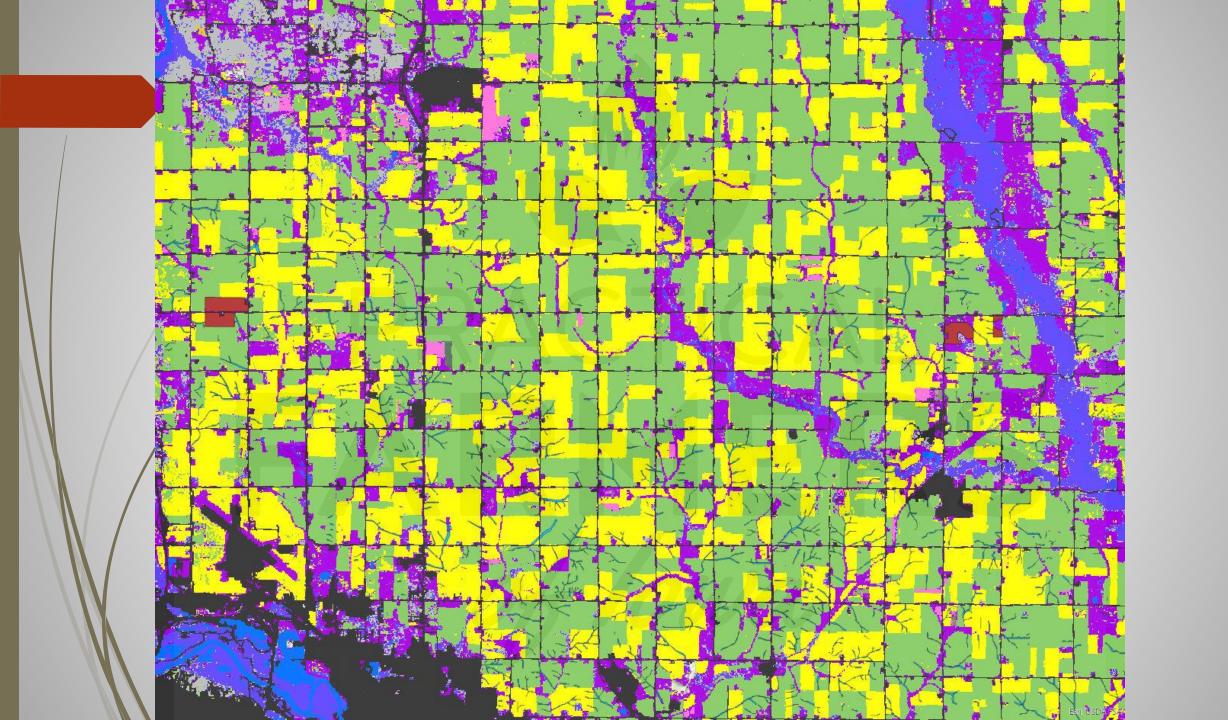
- No genetic structure among the CRP sites
- No evidence of inbreeding
- No correlation between genetic diversity and site-level vegetation variables
- Significant impact from landscape factors





Conclusion: natural habitats and semi-natural habitats are important





Acknowledgements

Iowa landowners who meticulously kept their seeding record, and allowed us to conduct survey on their land

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