


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

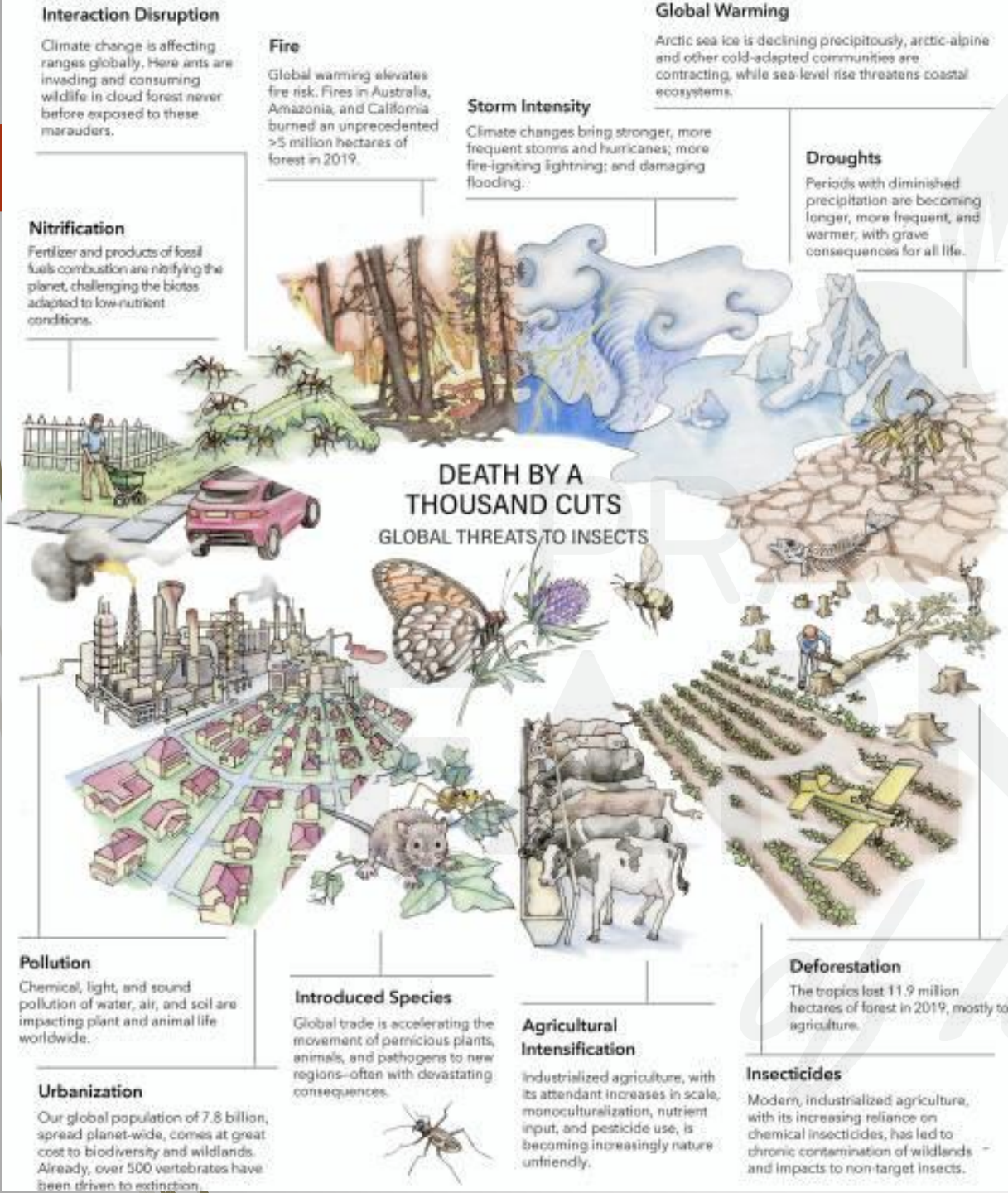
Ai Wen

January 20, 2024

University of Northern Iowa

of 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



“Death by a thousand cuts” —Many stressors act upon insects

Insect decline in the Anthropocene: Death by a thousand cuts

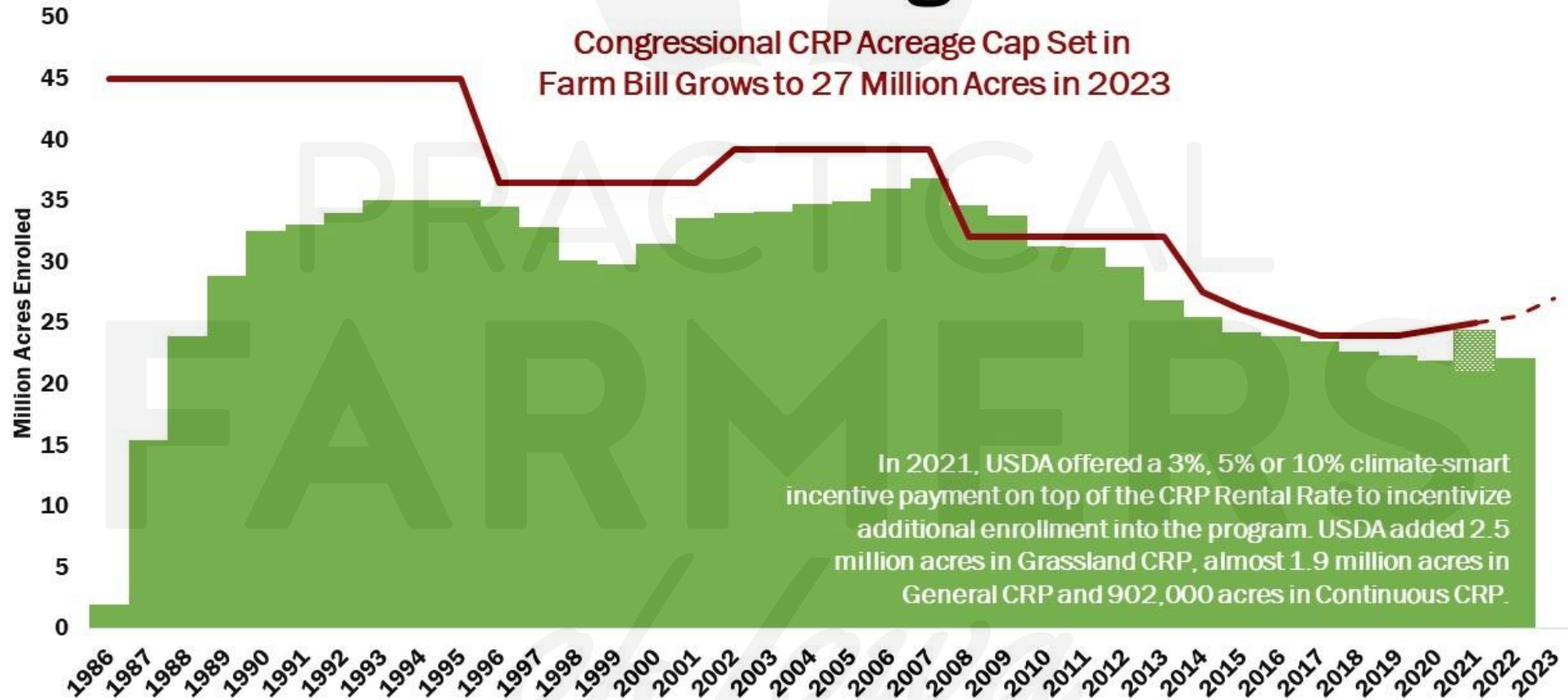
David L. Wagner^{a,1}, Eliza M. Grames^a, Matthew L. Forister^b, May R. Berenbaum^c, and David Stopak^d

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

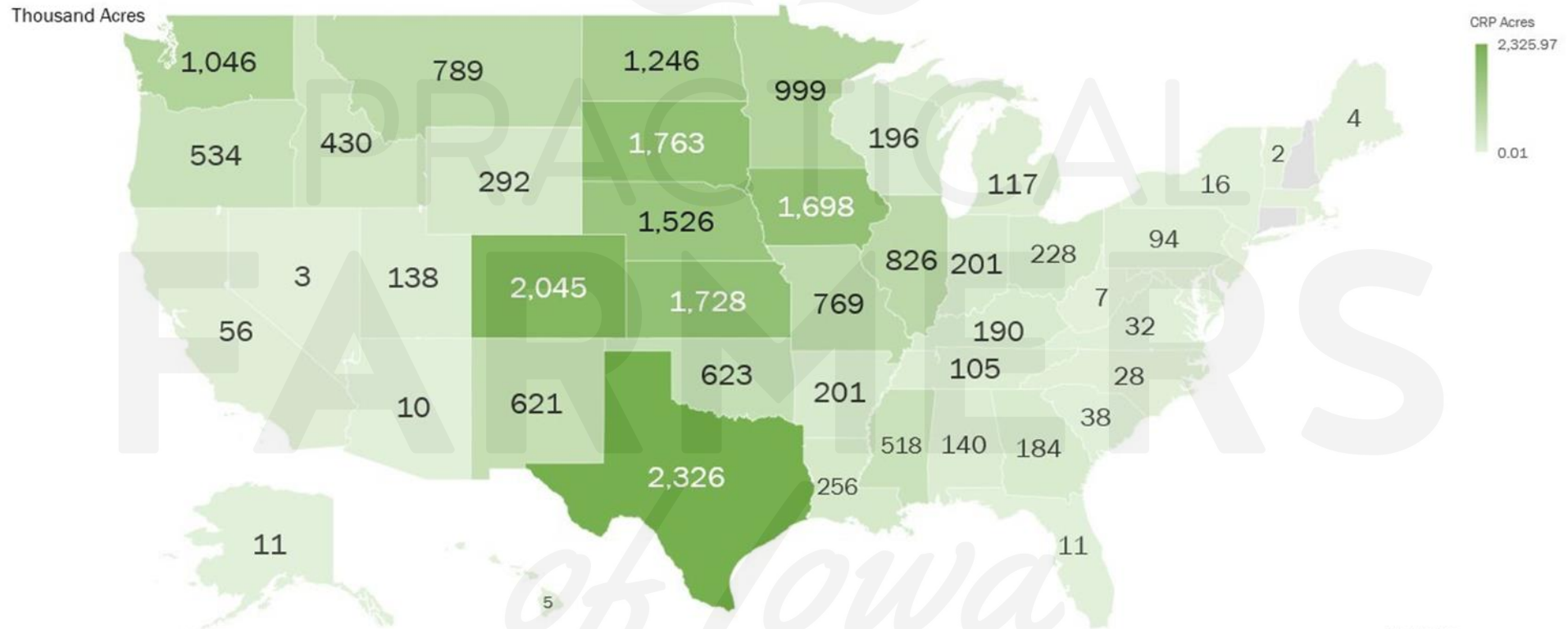
USDA Farm Service Agency-- Conservation Reserve Program (CRP)

Enrolled CRP Acres through 2022



➤ Question: Are the constructed CRPs doing its job?

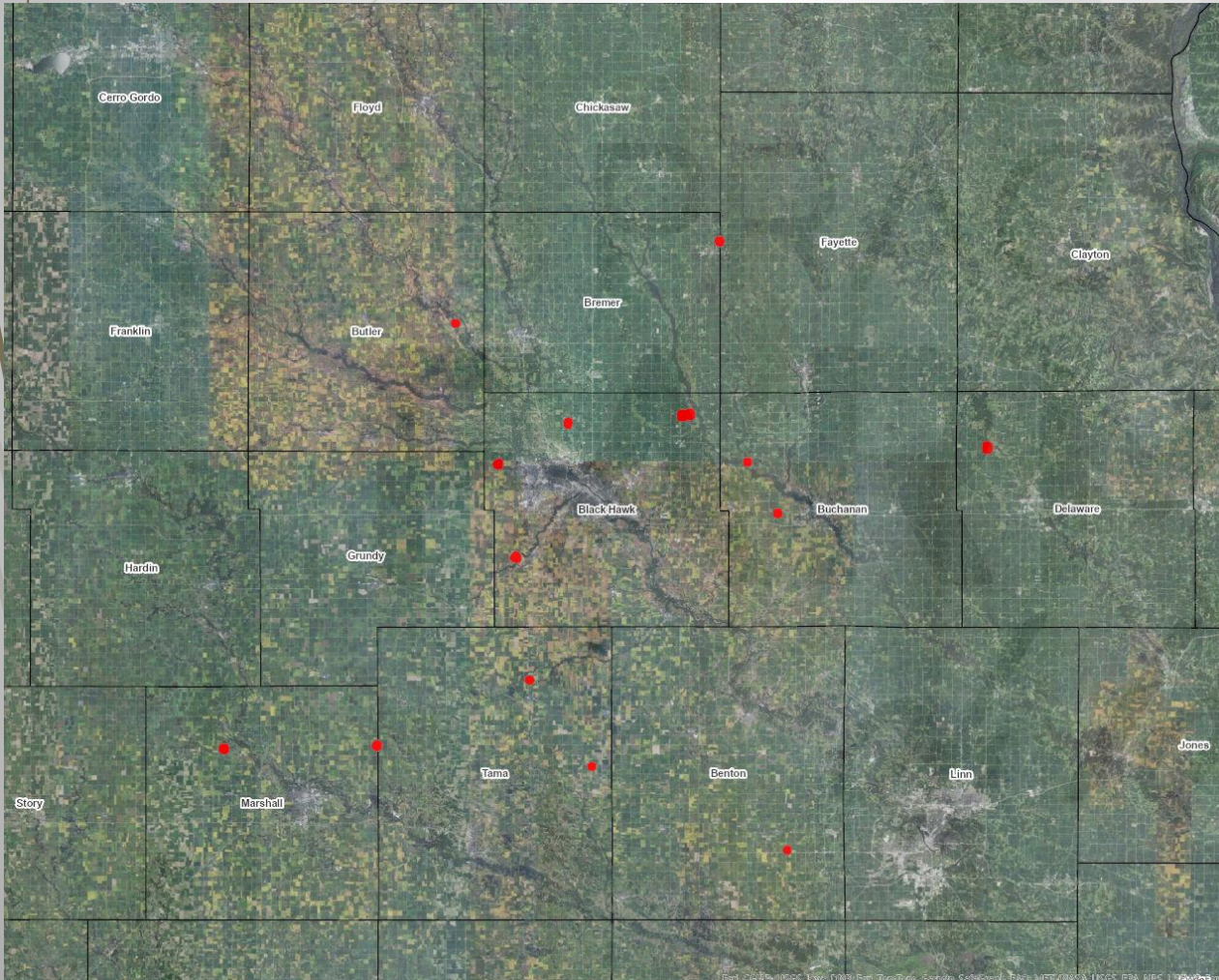
Enrolled CRP Acres in 2022 by State



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?

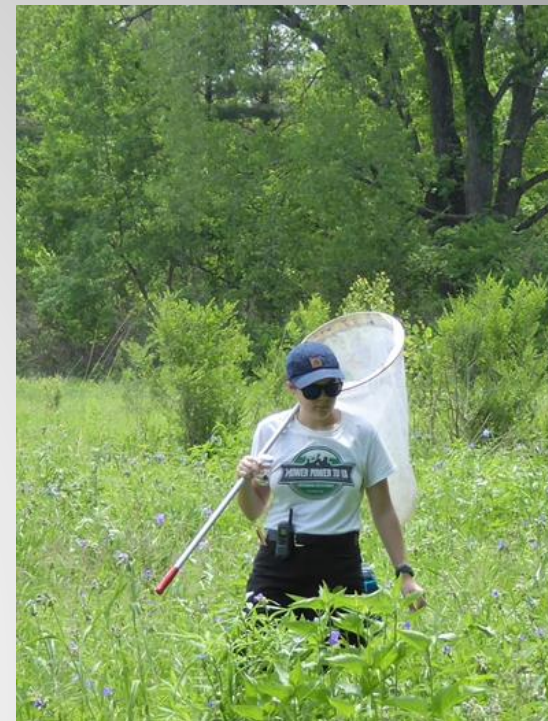


Since 2010, 160,000 ha of Pollinator Habitat Initiative CRP (CP-42) planted, about 42% of nationally established CP-42 acreages are in Iowa





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





Floral density



Floral diversity

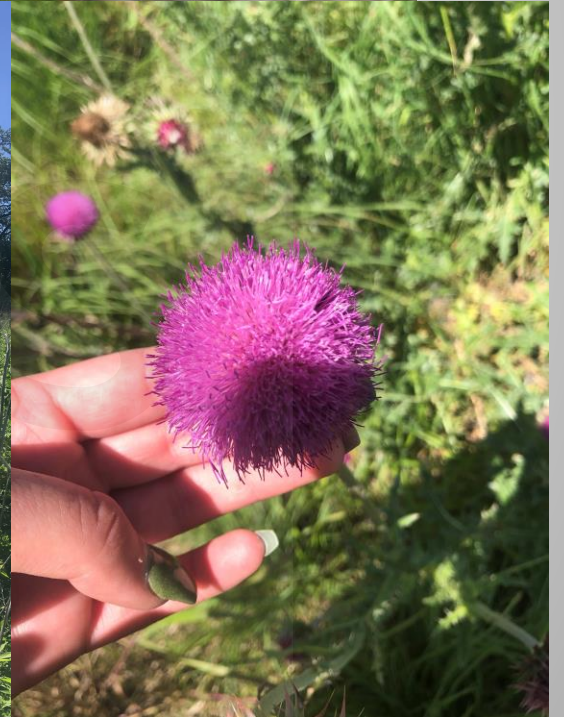
Photo credit: UNI undergraduate students



2010 © Peter M. Dziuk



Sown floral



Unsown floral

- 620 specimens of 76 wild bee species
- Collected from 37 floral sources

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

- 620 specimens of 76 wild bee species
- Collected from 37 floral species



Protandrena albitarsis

Photo by Lopez-Urbe lab



Bombus rufocinctus



Bombus borealis

Andrena

➤ The most “bee friendly” sown flowers

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

➤ The most “bee friendly” sown flowers

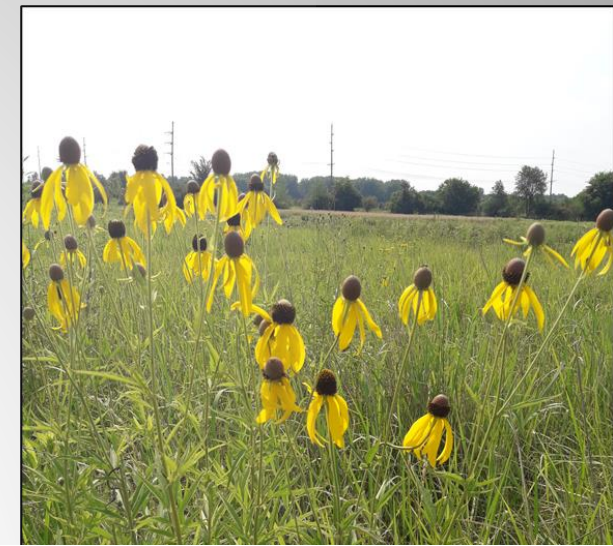
2010 © Peter M. Dziuk



Bee balm (177 bees)



Partridge peas (60 bees)



Gray headed
coneflower (51 bees)



Black-eyed Susan
(38 bees)

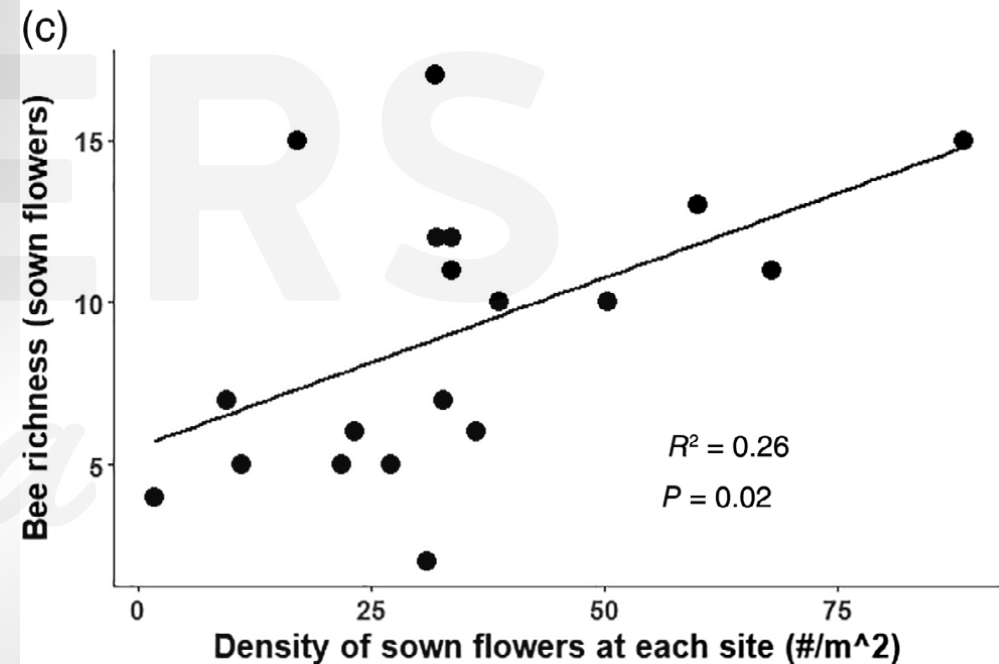
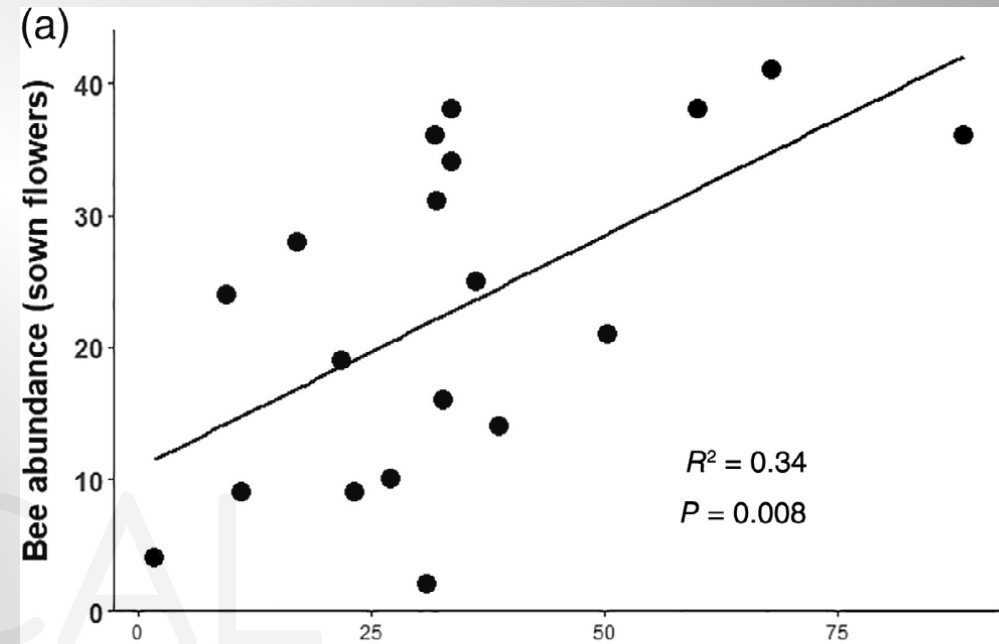
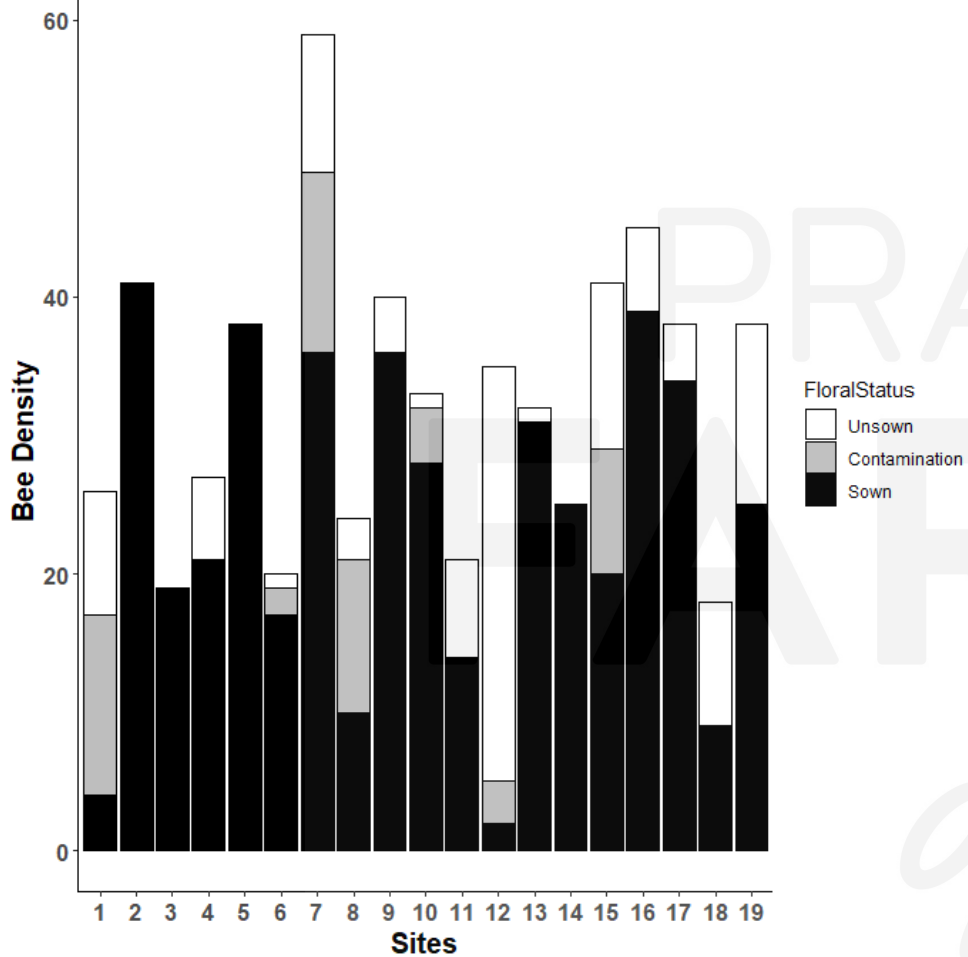


Purple coneflower
(36 bees)



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
<i>Securigera varia</i>	27	4
<i>Daucus carota</i>	22	7
<i>Cirsium arvense</i>	21	15
<i>Crepis tectorum</i>	9	6
<i>Cirsium vulgare</i>	8	3
<i>Trifolium repens</i>	7	4
<i>Lactuca serriola</i>	5	2
<i>Erigeron annuus</i>	3	3
<i>Trifolium pratense</i>	3	3
<i>Hypericum punctatum</i>	2	2
<i>Pastinaca sativa</i>	2	1
<i>Trifolium hybridum</i>	2	2
<i>Erigeron strigosus</i>	1	1
<i>Hypericum pyramidatum</i>	1	1

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Crown vetch
(27 bees)



Queen Ann's lace
(22 bees)



Canada thistle (21 bees)

of Iowa

➤ The most “bee friendly” unsown flowers

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<i>Trifolium hybridum</i>	2	2
<i>Erigeron strigosus</i>	1	1
<i>Hypericum pyramidatum</i>	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

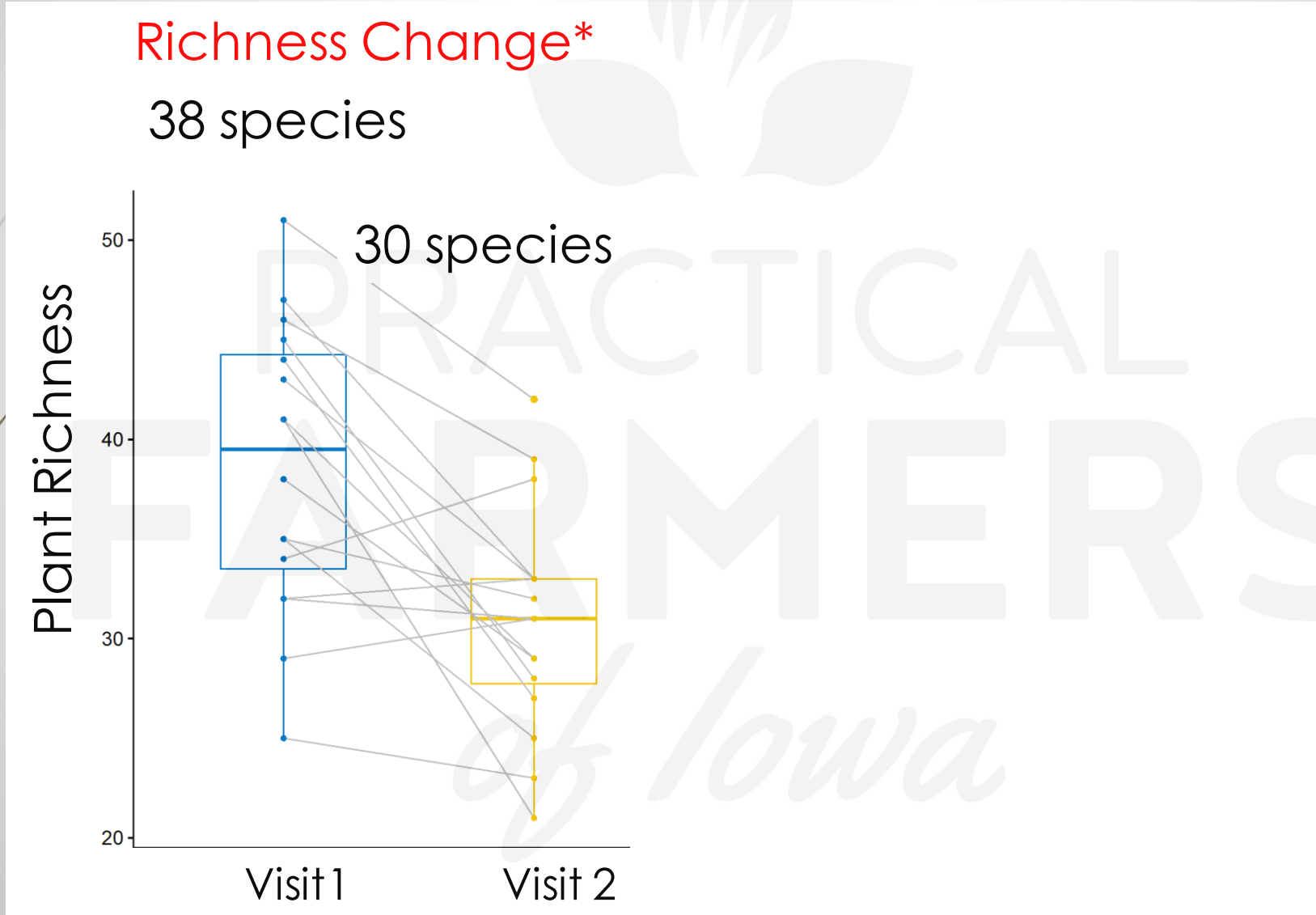


.....Four years later
Repeated visits in 2022-2023

- Native grass establishment keeps weed level down

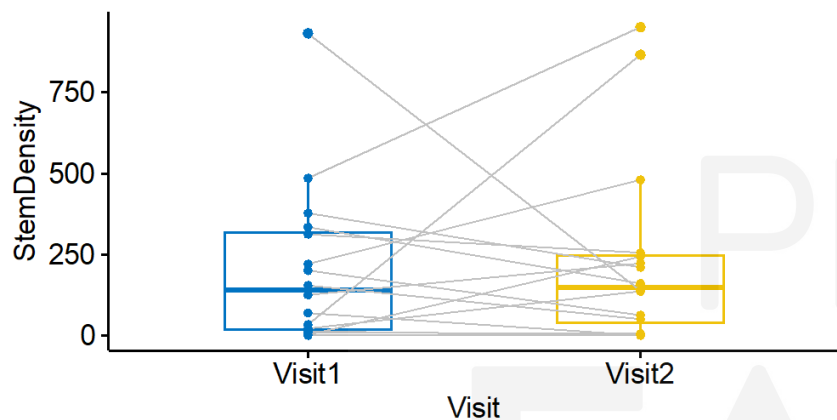


Four years later Repeated visits in 2022-2023

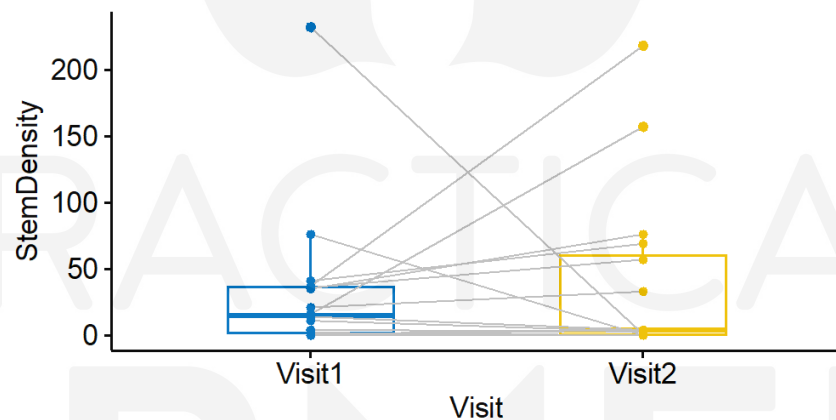


Plant stem density change

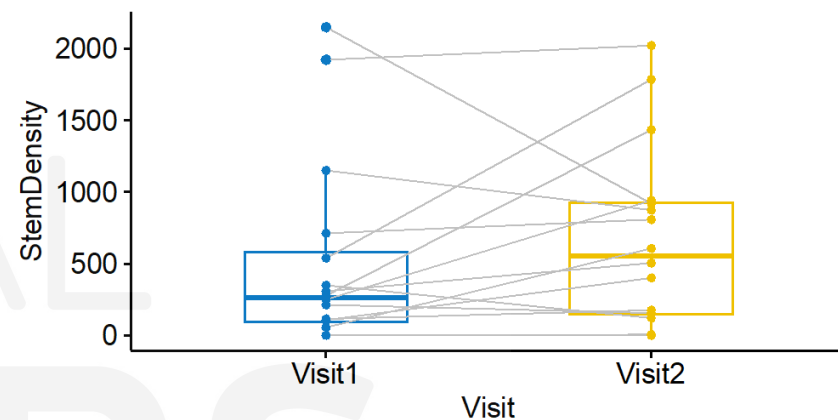
Canada thistle



Purple prairie clover



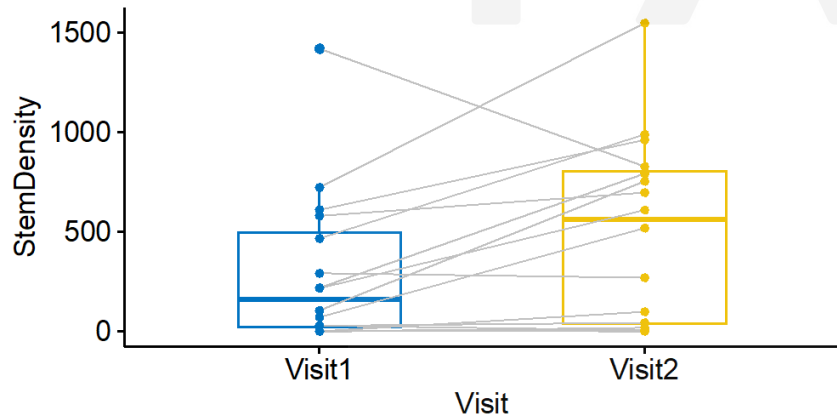
Bee balm



Gray-headed coneflower

297 stems

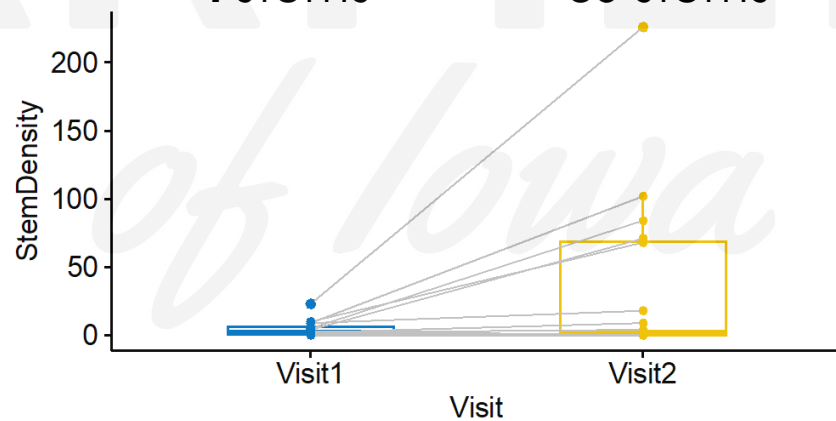
508 stems



Golden Alexander

4 stems

36 stems



<https://val.vtcostudies.org/projects/vtbees/andrena-ziziae/>

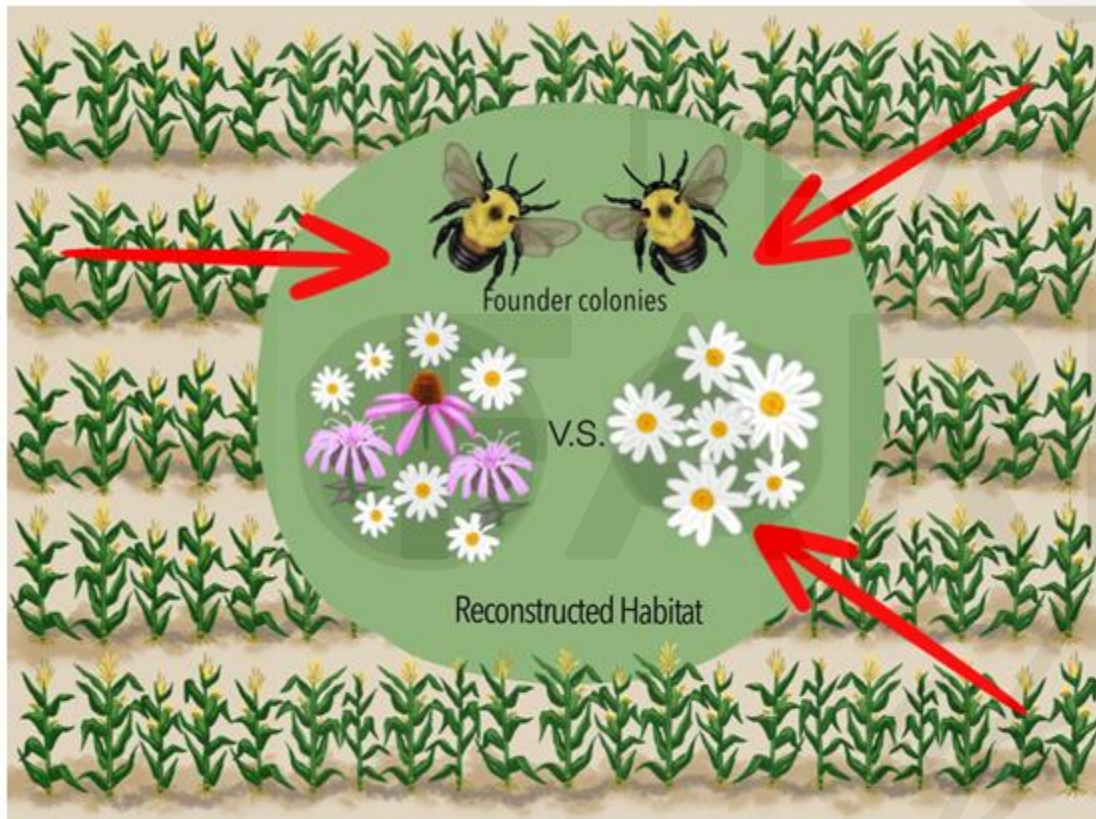
Andrena ziziae



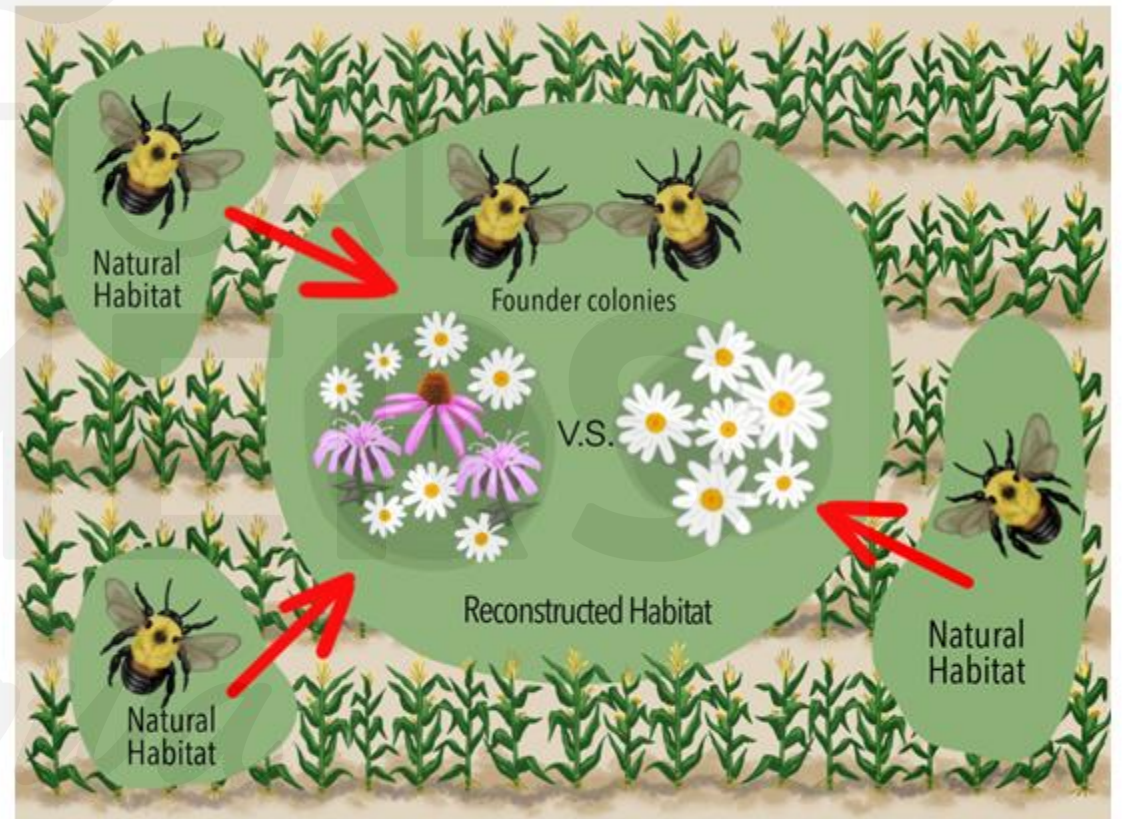
➤ Question: Are the bees all genetically related?



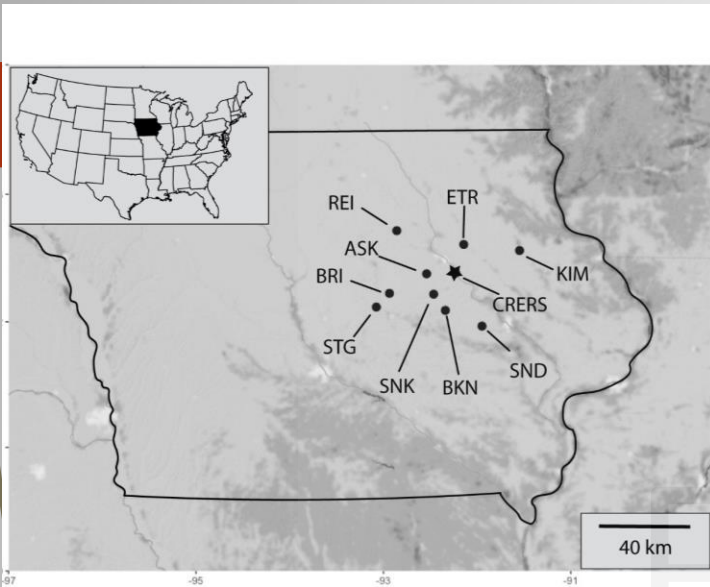
a



b



Time since reconstruction
↓



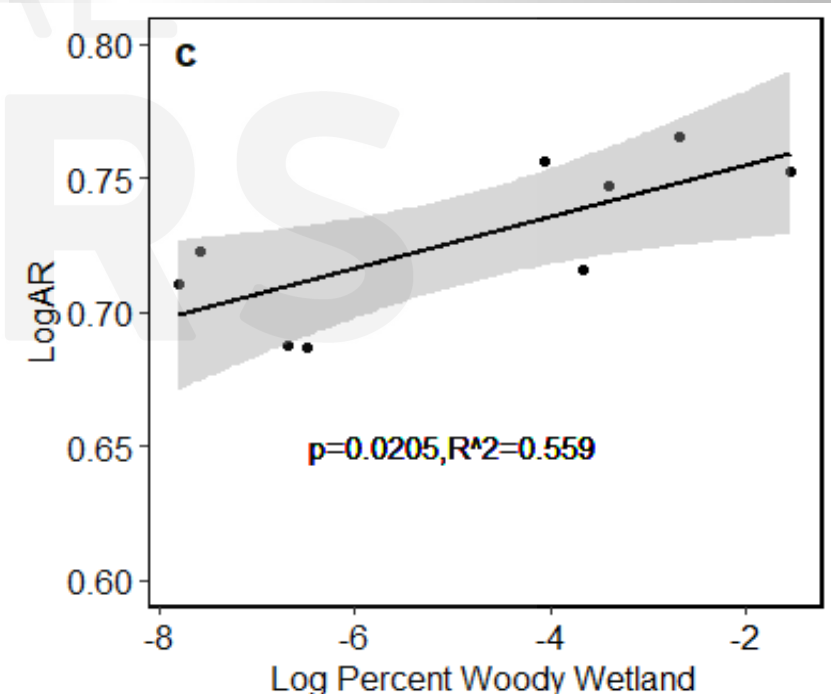
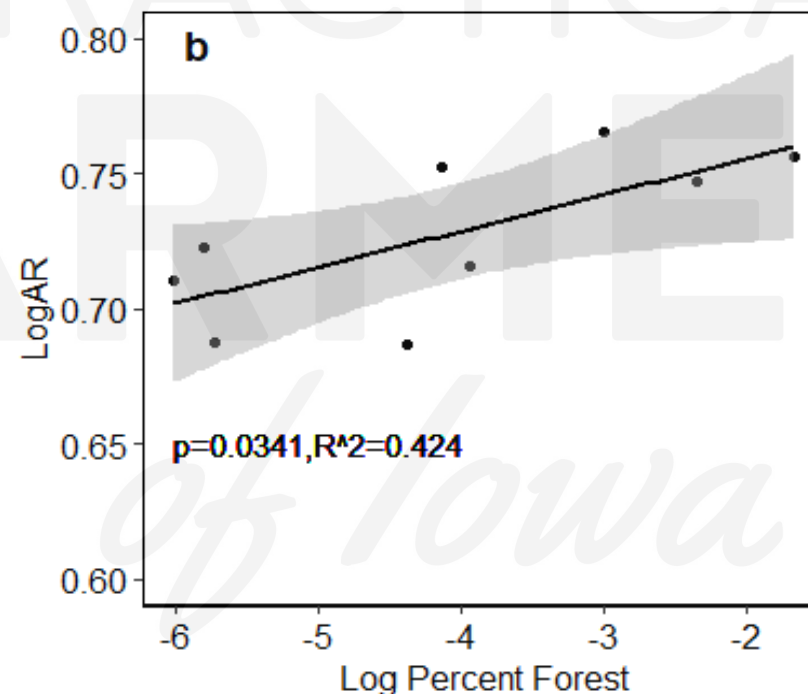
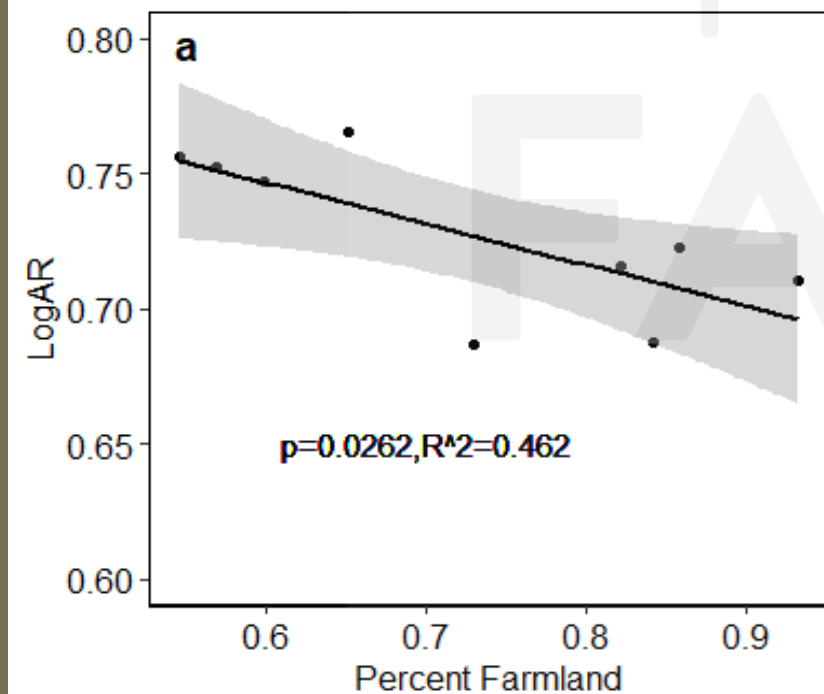
- 9 CRP sites and 1 reference site
- 5-23 *B. griseocollis* collected from each site
- Microsatellite method to measure the genetic structure of the bumblebee population at each site
- Landscape variables



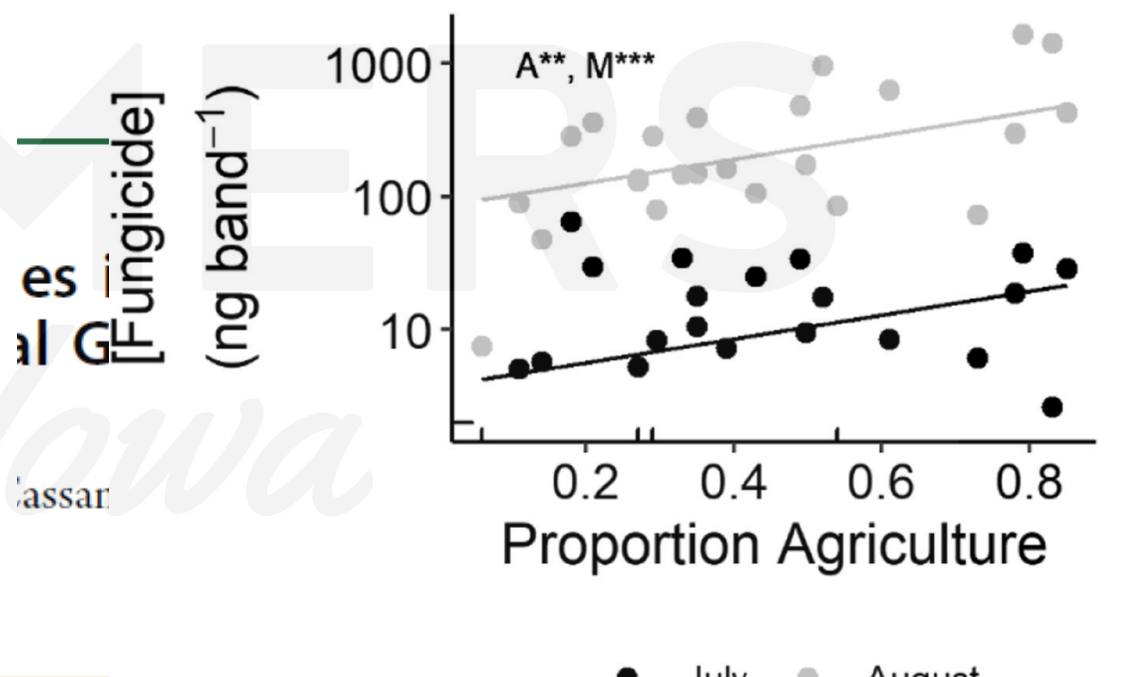
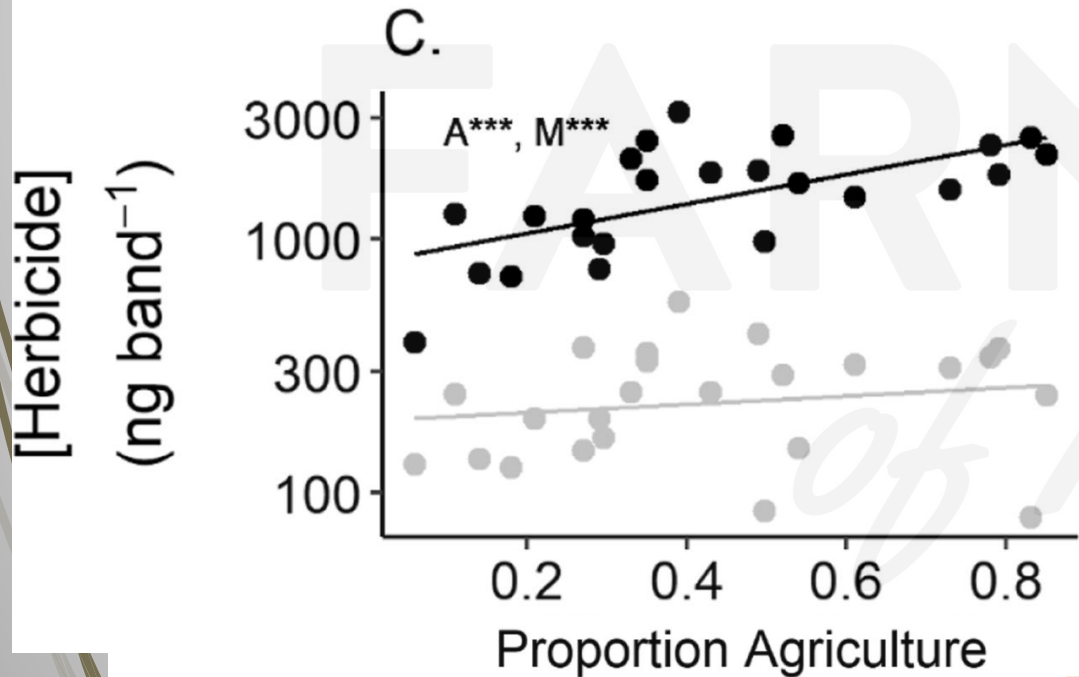
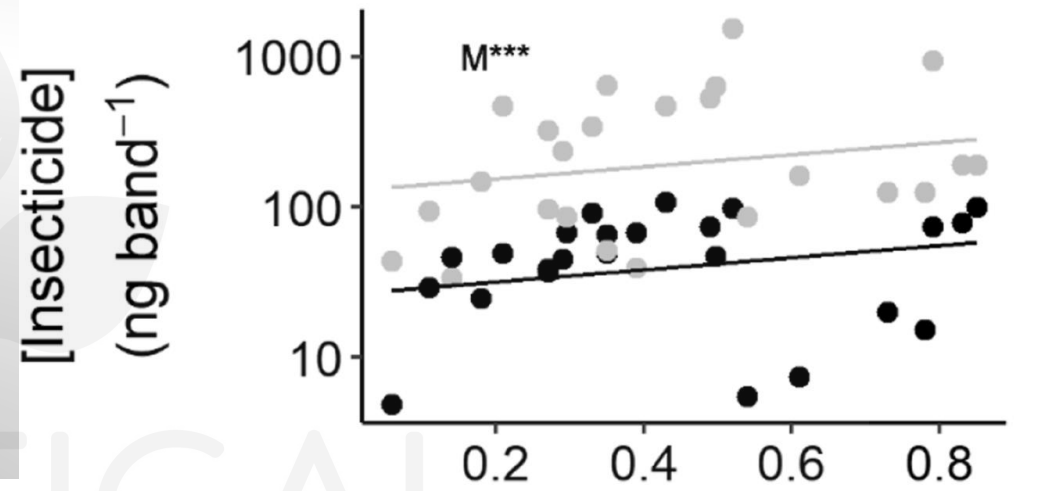
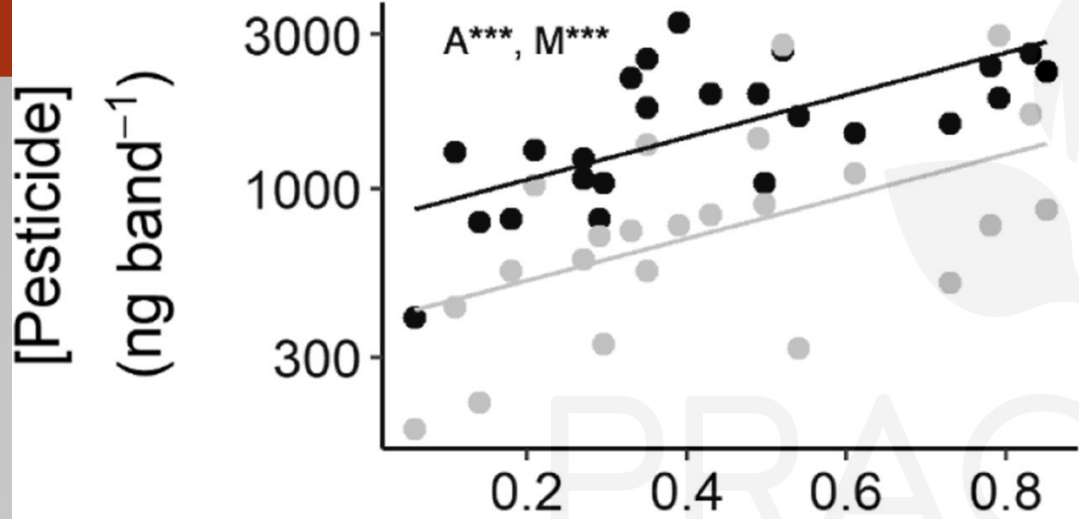
Bombus griseocollis
(Brown-belted bumblebee)



- 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



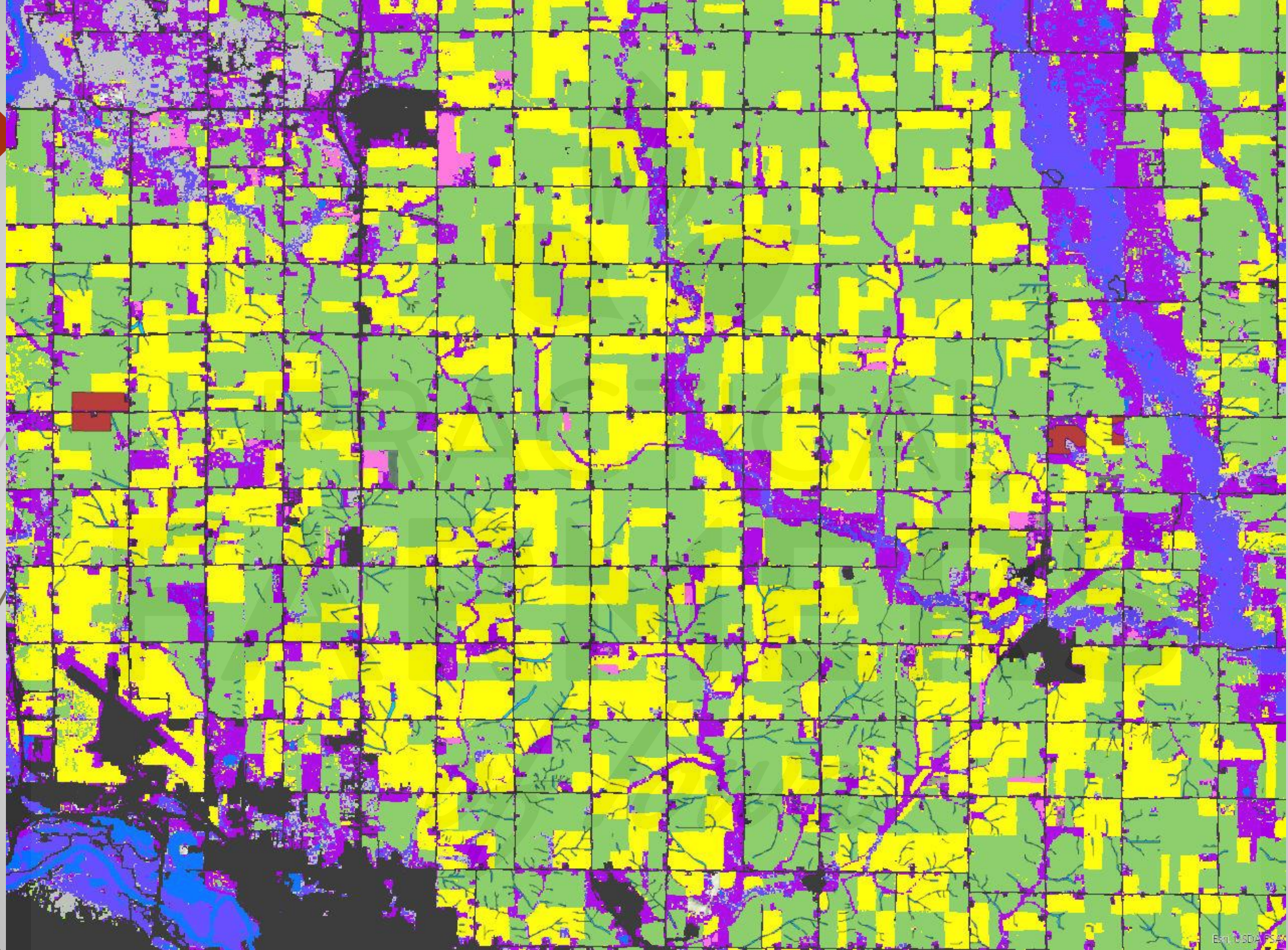
❖ Conclusion: natural habitats and semi-natural habitats are important



- ❖ Conclusion: natural habitats and semi-natural habitats are important



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Acknowledgements

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

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