

WEED AND APPLIED PLANT ECOLOGY

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Thinking Through Non-Target Effects

Dave Mortensen, Distinguished Professor

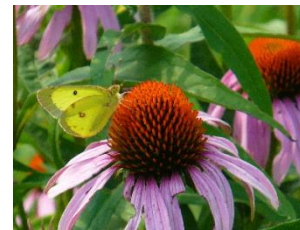
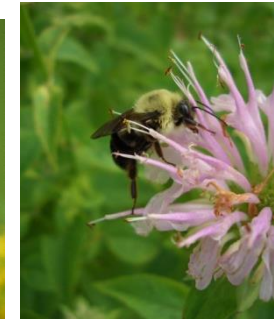
Plant Sciences Department

Penn State University

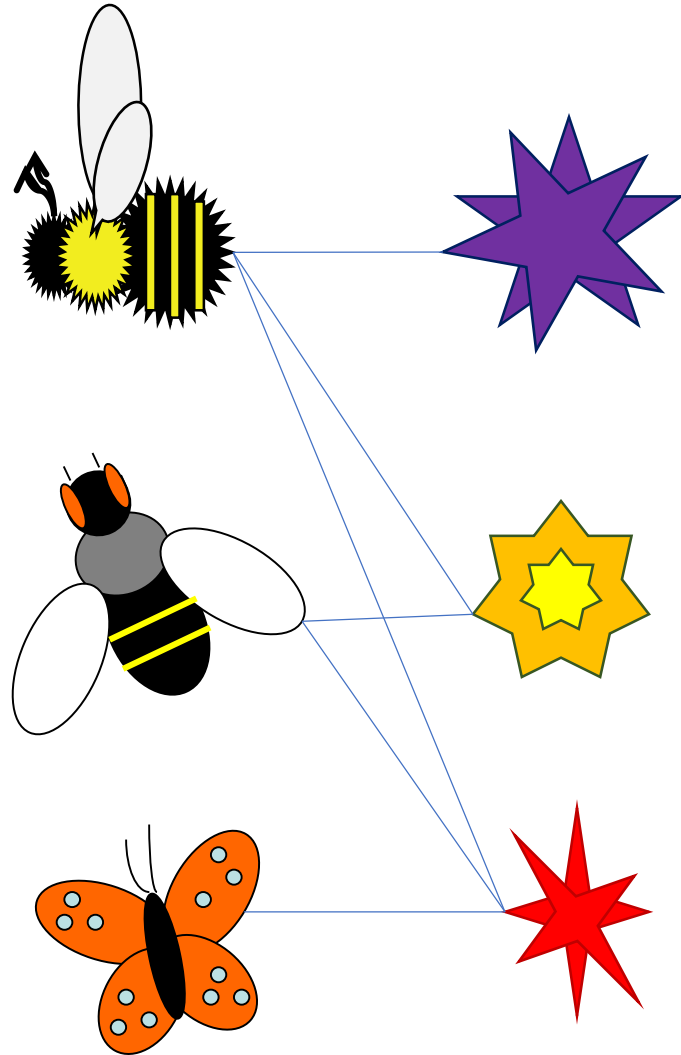
dmortensen@psu.edu

<http://www.weedecologypsu.com/>

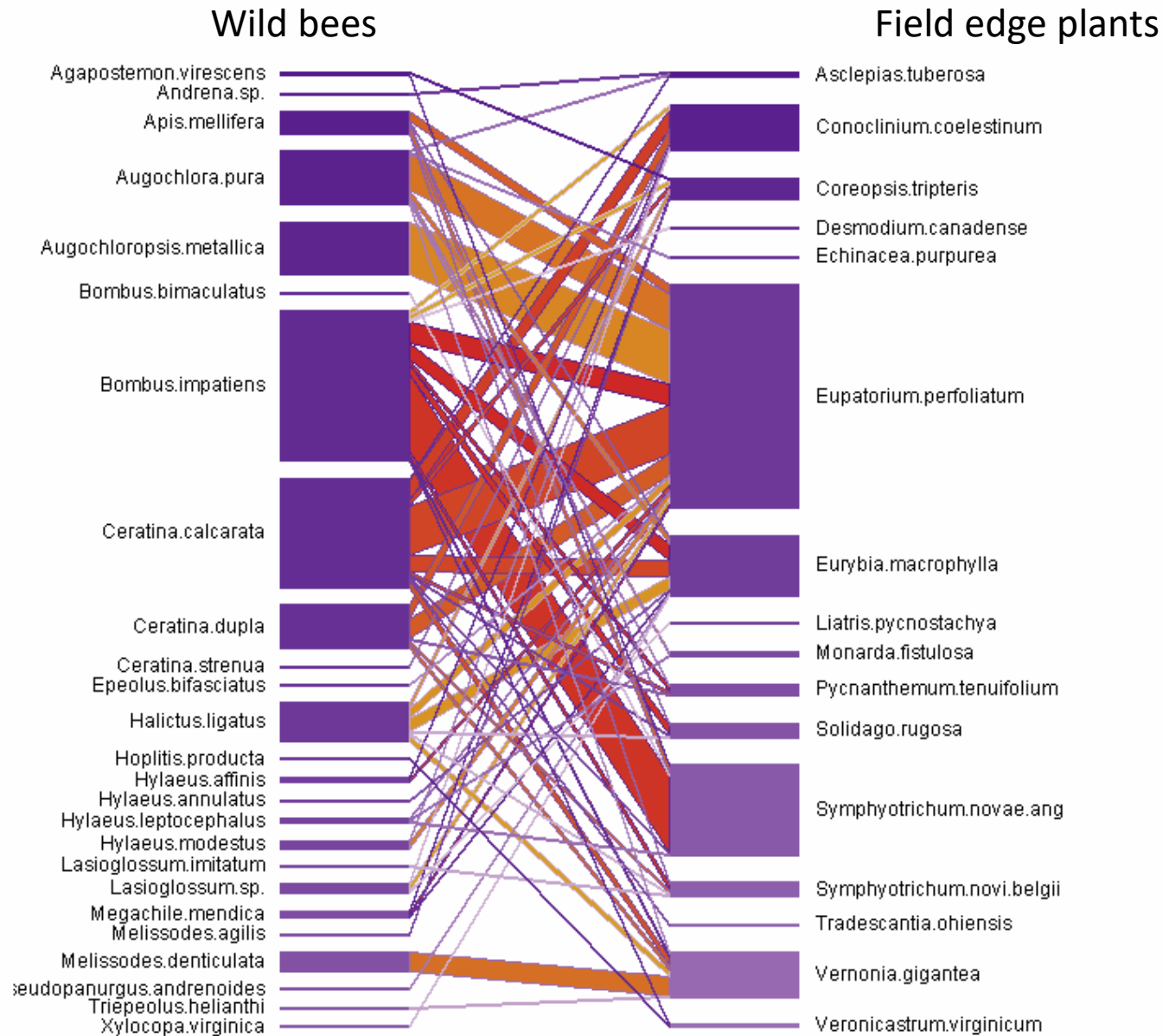
Landscaping with native plants



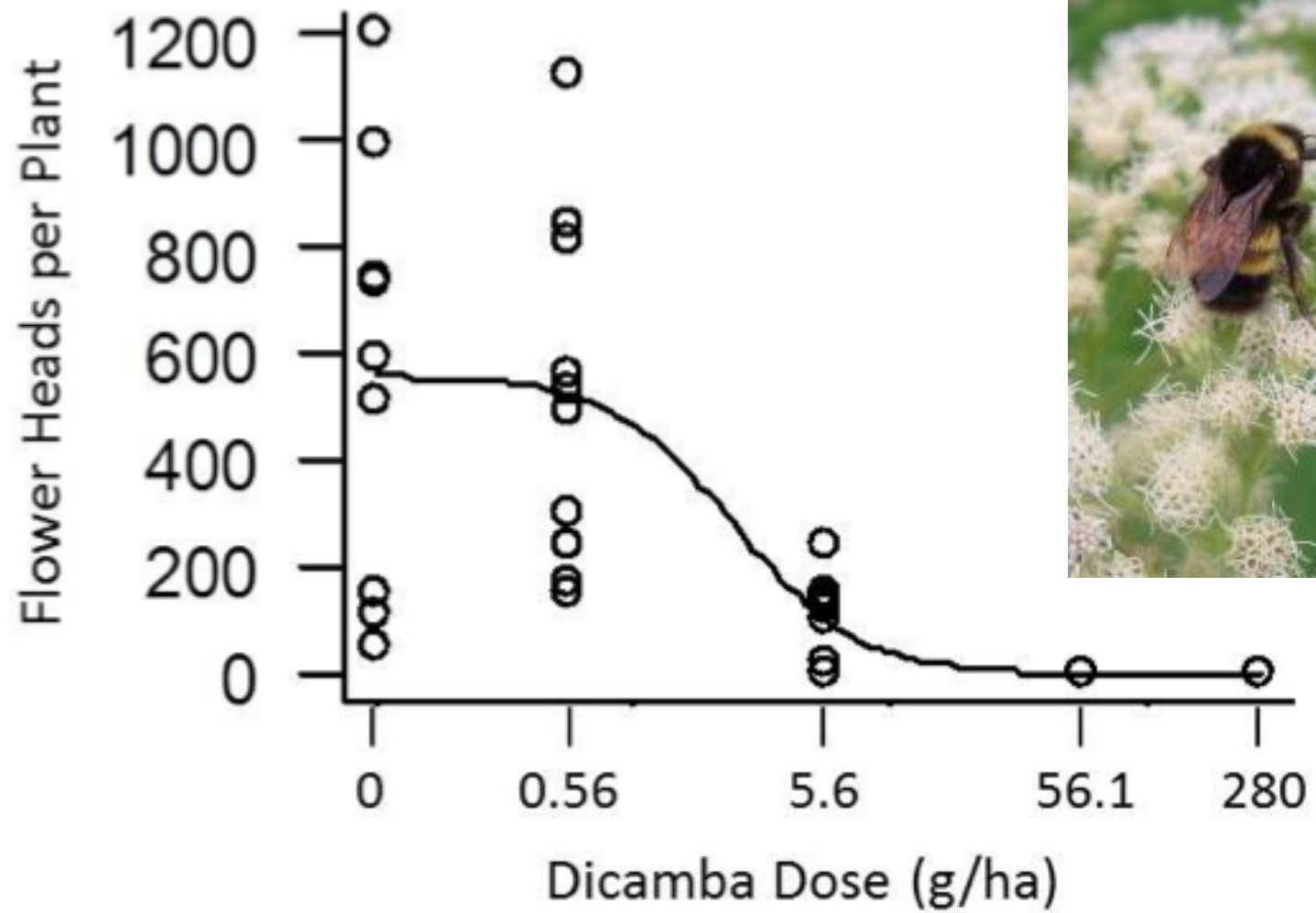
Bipartite Networks



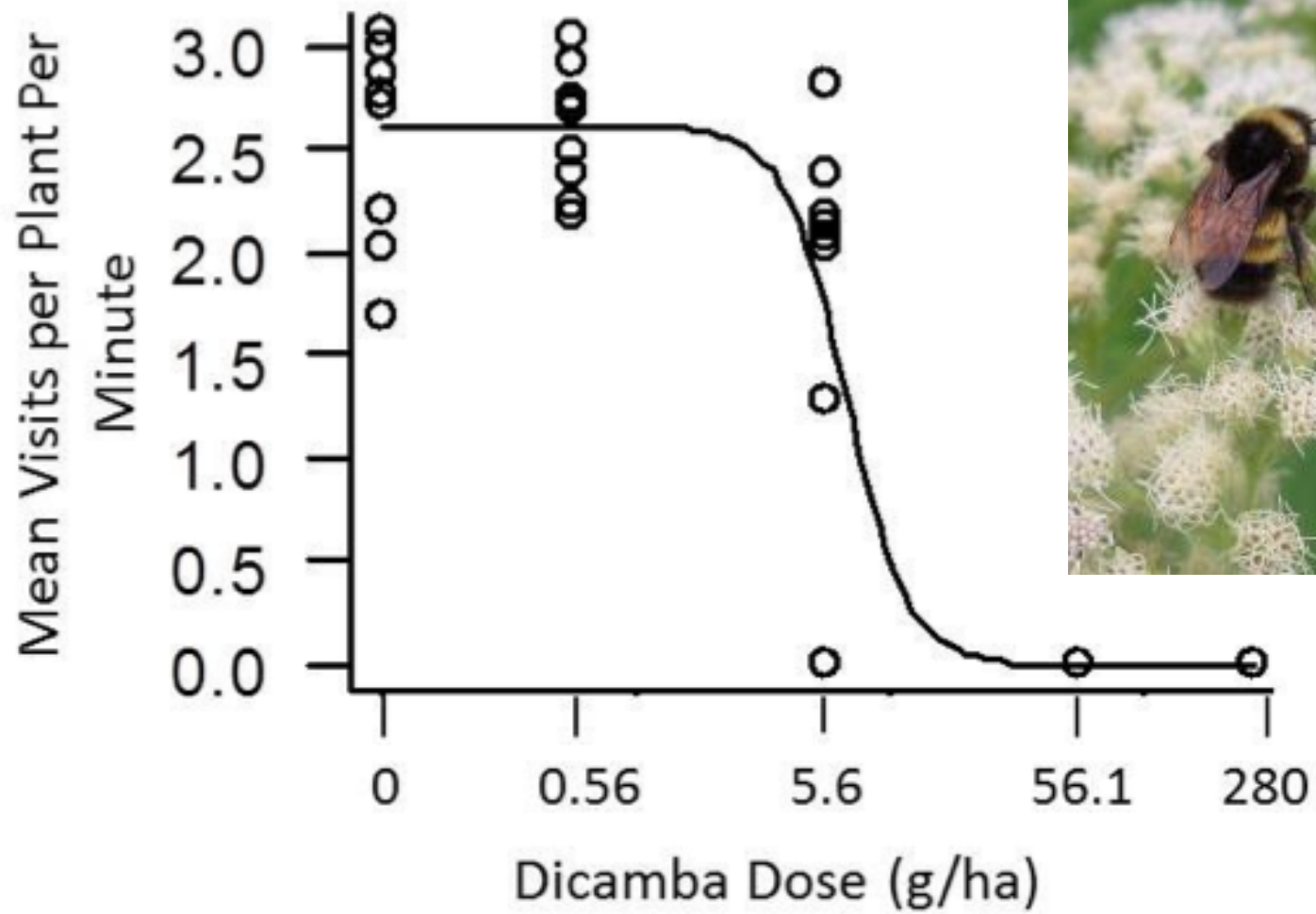
- Method for evaluating the structure of interactions
- Tool for picking out important species



Russo, L, N DeBarros, S Yang, K Shea, and D Mortensen. 2013. Supporting crop pollinators with floral resources: network-based phenological matching. Trends in Ecology and Evolution, 1-16



Bohnenblust, Vaudo, Egan, Mortensen, and Tooker. 2016. Effects of the herbicide dicamba on non-target plants and pollinator visitation. *Environmental Toxicology and Chemistry, Journal of Pest Science*, 35:144-151.



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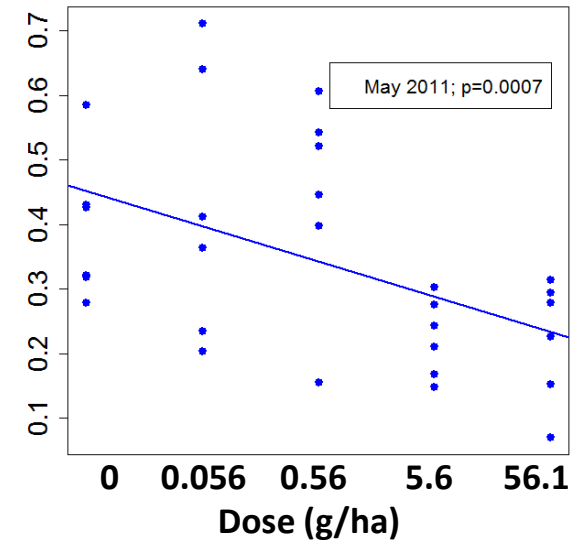
Broadleaf crop and field edge plant communities don't like herbicide drift



The scientists found that application of dicamba inhibited or delayed flowering in common boneset (*Eupatorium perfoliatum*), resulting in significantly reduced visitation by insect species, including honeybees (pollinators) and syrphid flies (natural enemies). The image shows a damaged *E. perfoliatum* plant that received a rate of 56 grams of dicamba per hectare.s



Proportion Broadleaf Cover

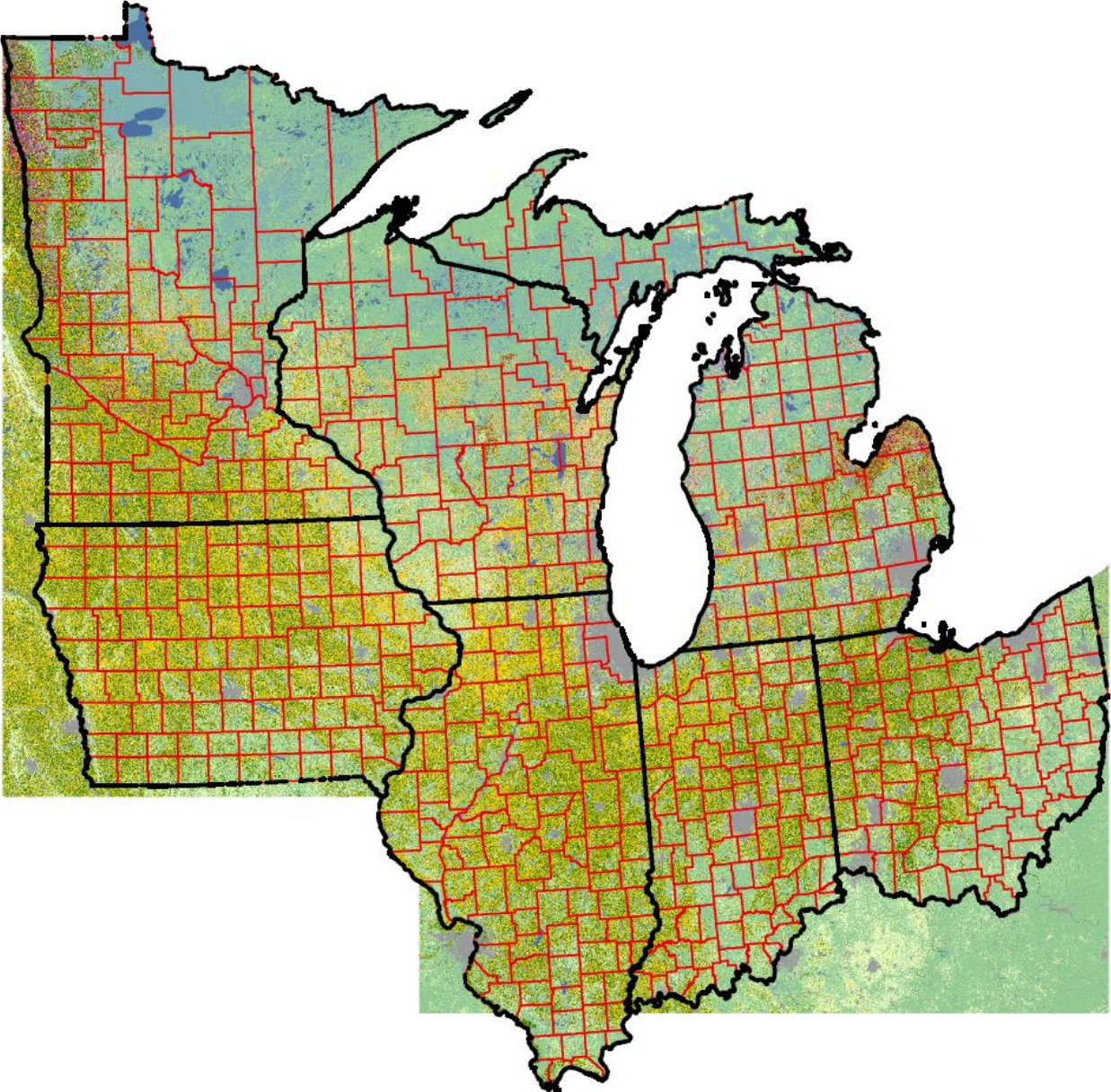


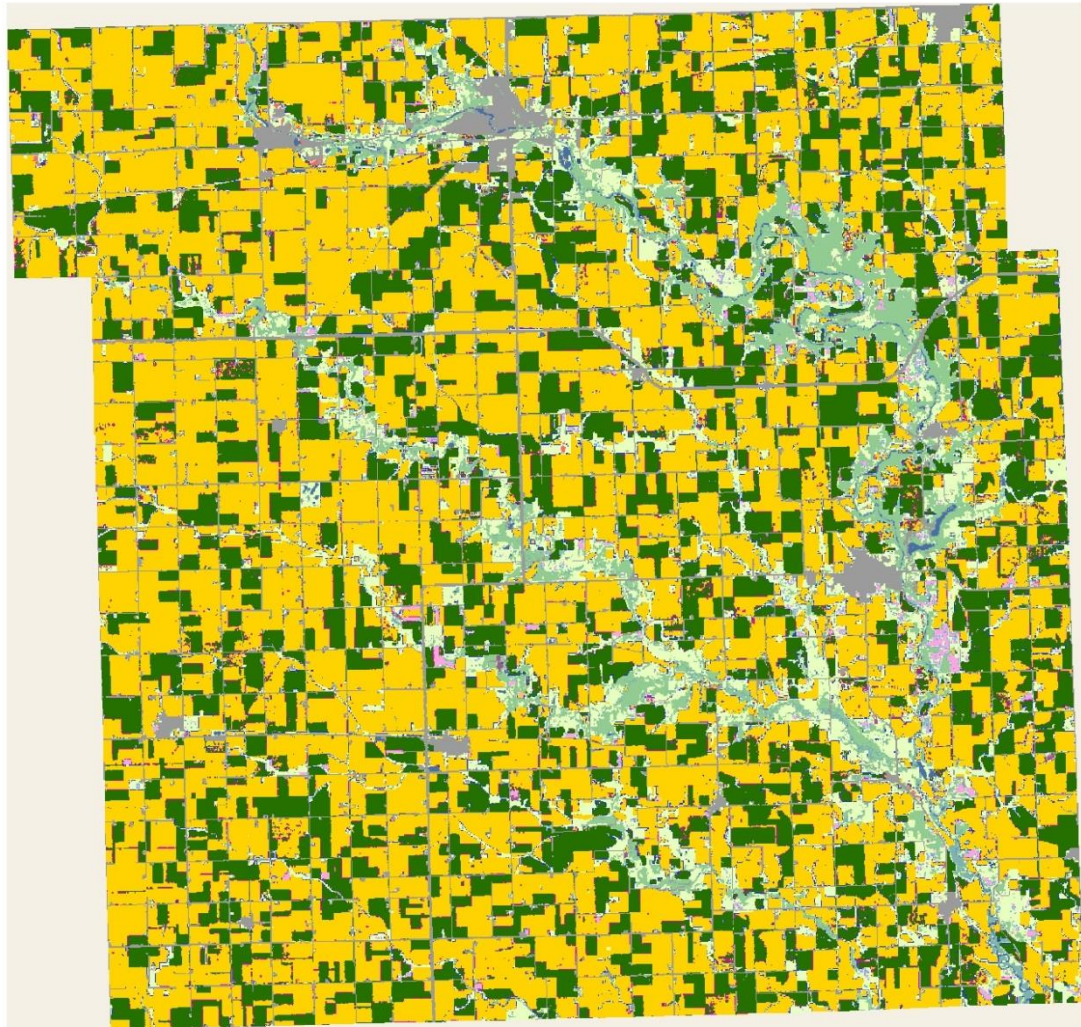
Egan, Bohnenblust, Goslee, Mortensen, and Tooker. 2014. Herbicide drift can affect plant and arthropod communities.

Agriculture, Ecosystems, and Environment

Egan, Graham, and Mortensen. 2014. A comparison of the herbicide tolerances of rare and common plants in an agricultural landscape. *Environmental Toxicology and Chemistry*

USDA National Agriculture Statistics Service 'Crop Data Layer'



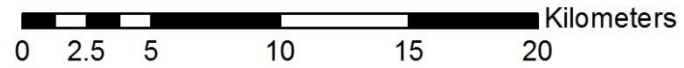


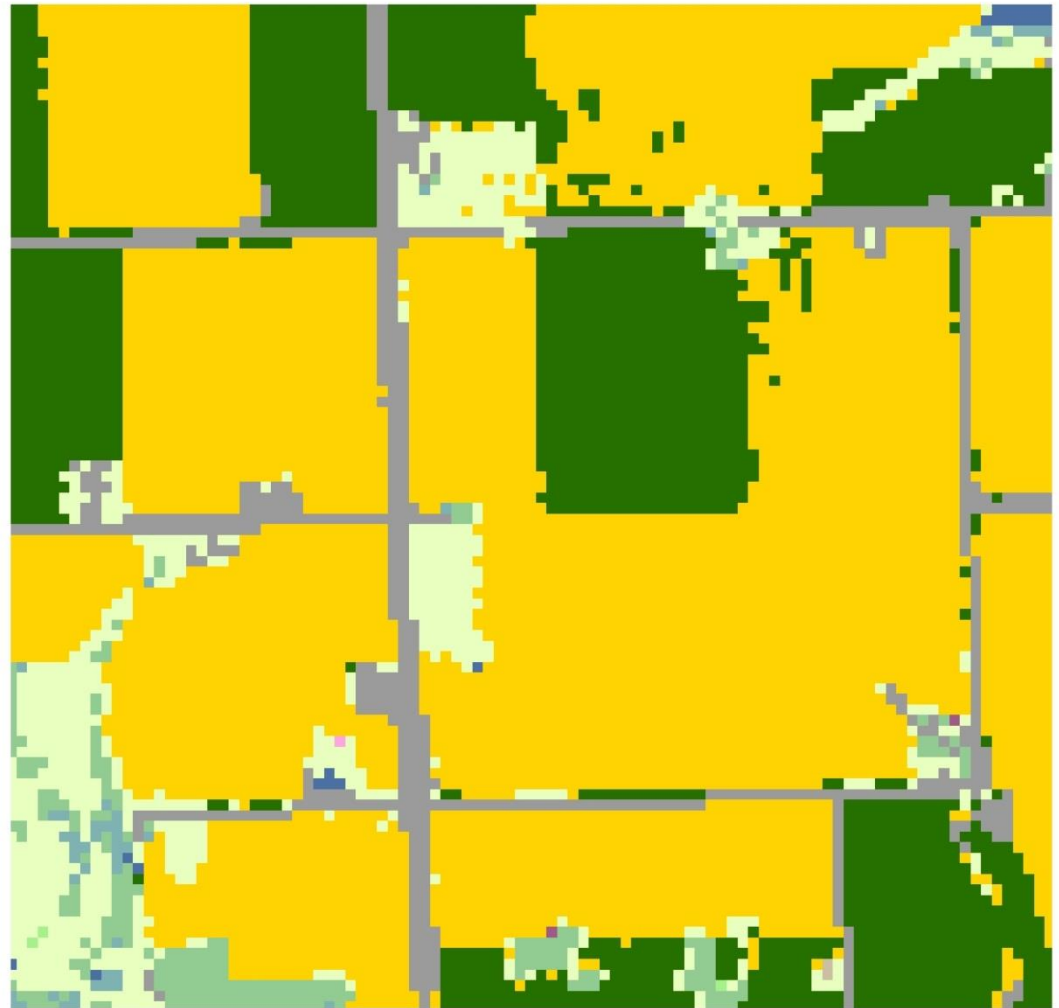
Legend

-  Corn
-  Soybeans
-  Wheat
-  Oats
-  Alfalfa
-  Water
-  Developed
-  Forest
-  Shrubland
-  Grass/Pasture
-  Wetlands
-  Other
-  Soy/Corn-Natural Edge
-  Other Arable-Natural Edge
-  Soy/Corn-Arable Edge



Hardin County, Iowa USA

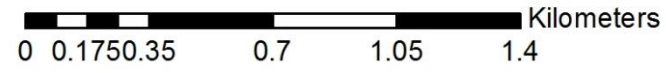




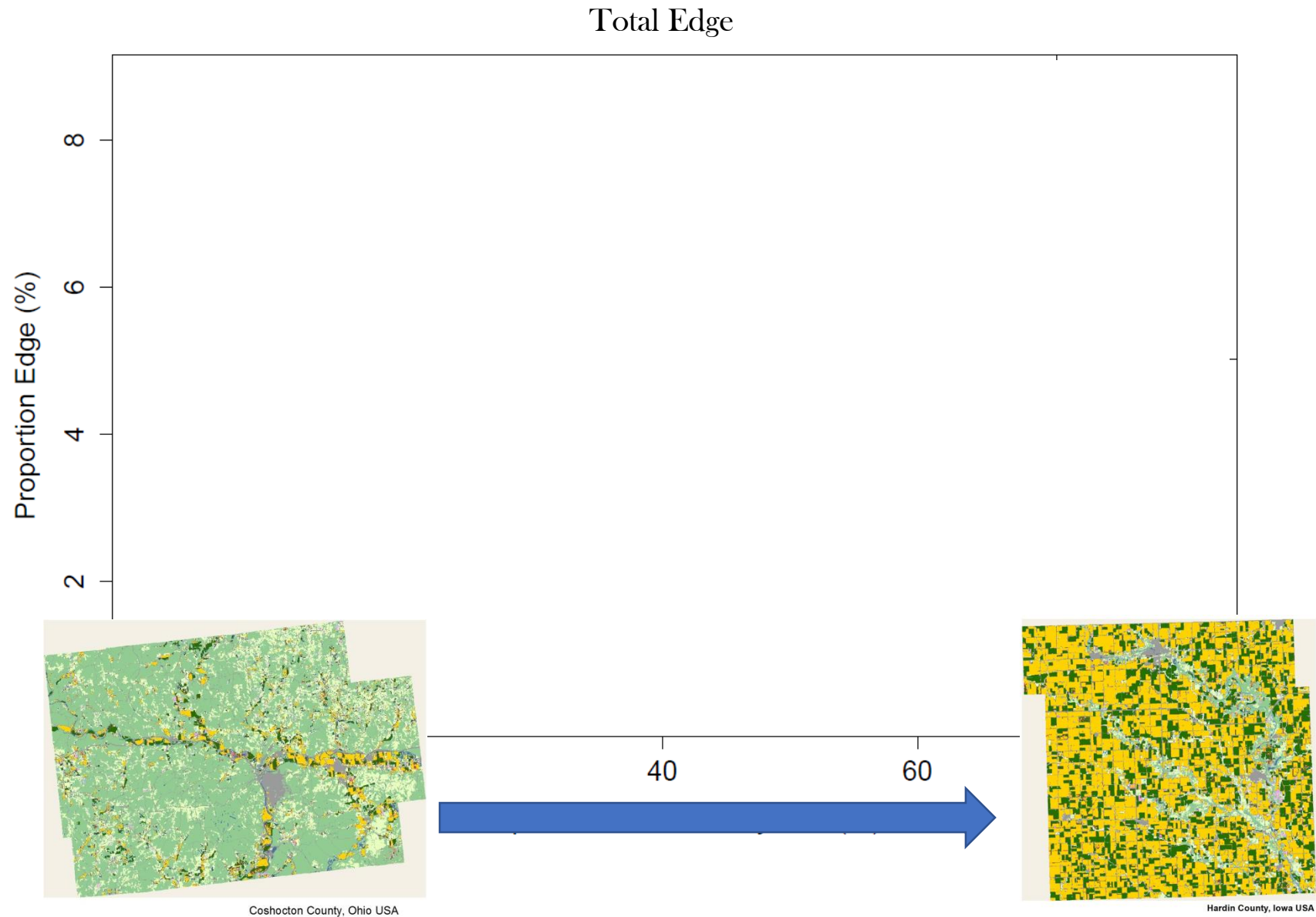
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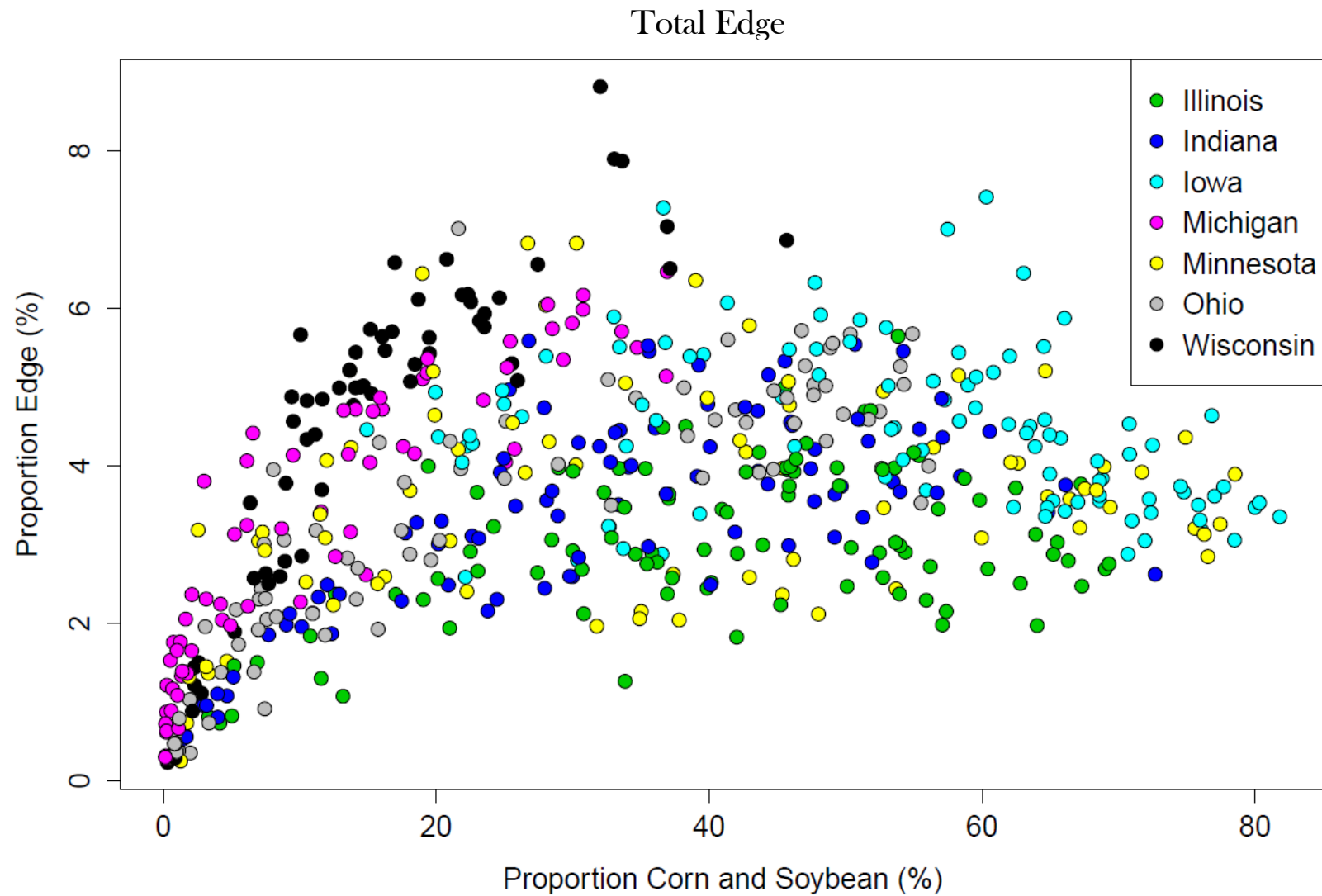
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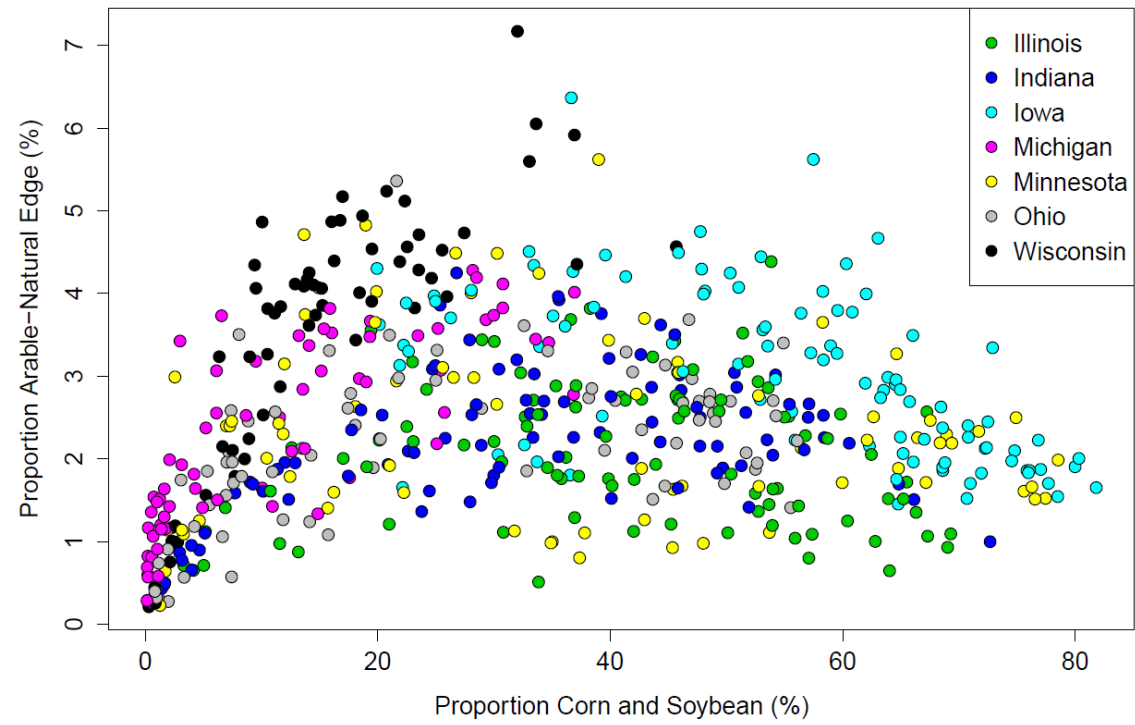
How much edge is there in Midwestern agricultural landscapes?



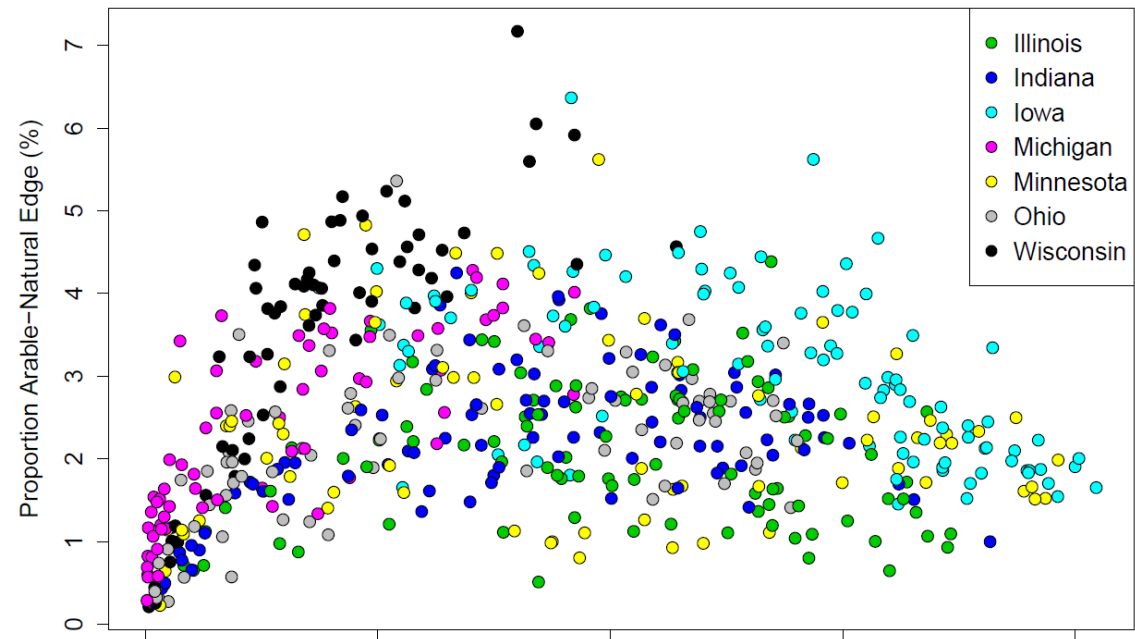
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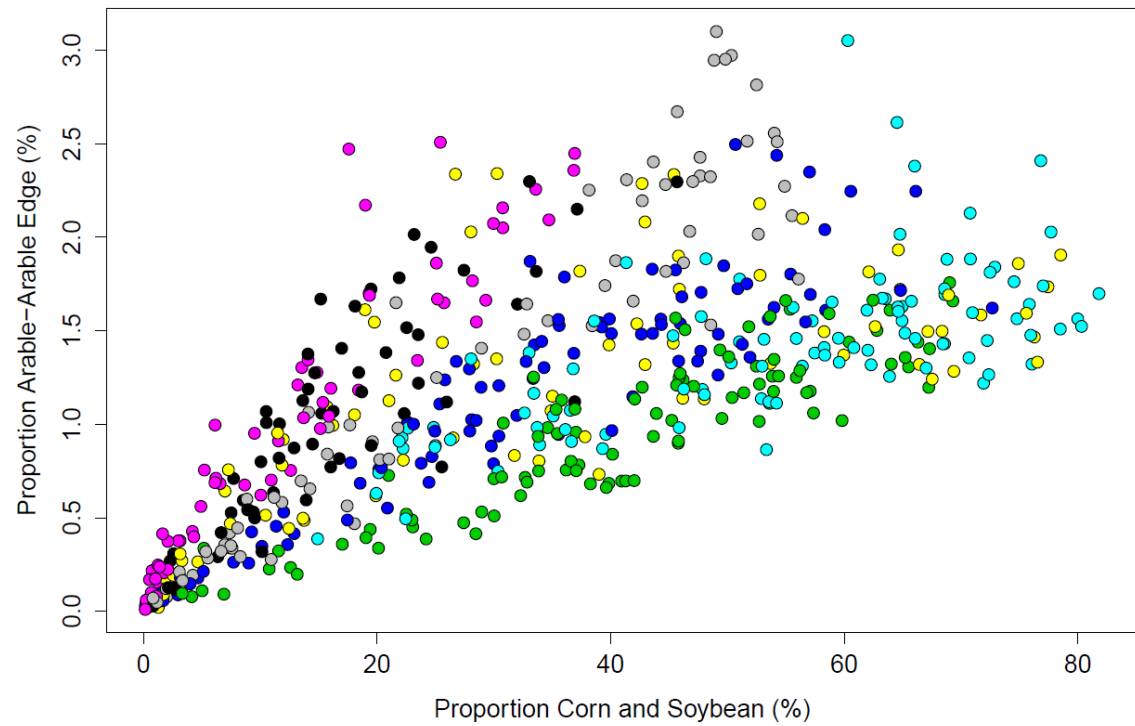
Arable-Natural Edge

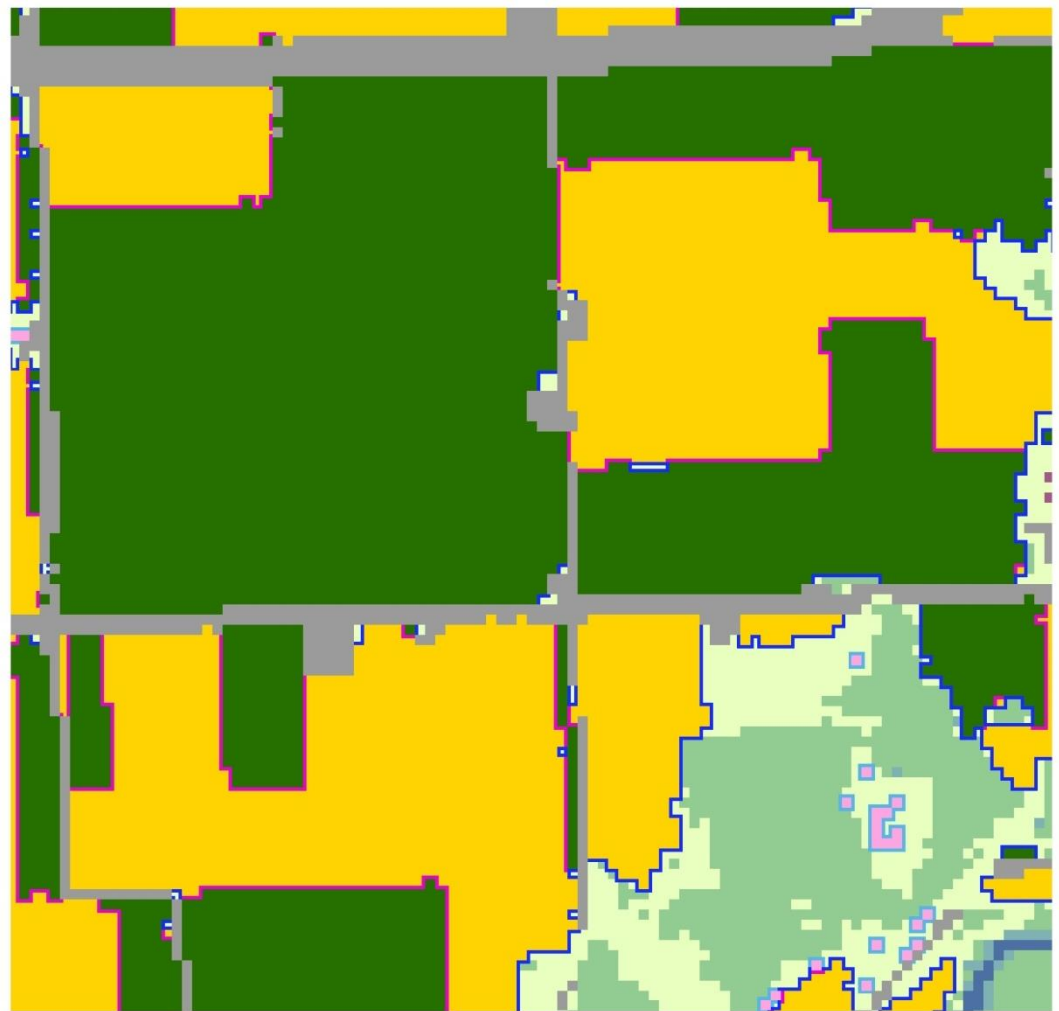


Arable-Natural Edge



Arable-Arable Edge

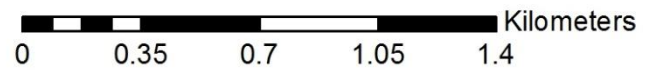




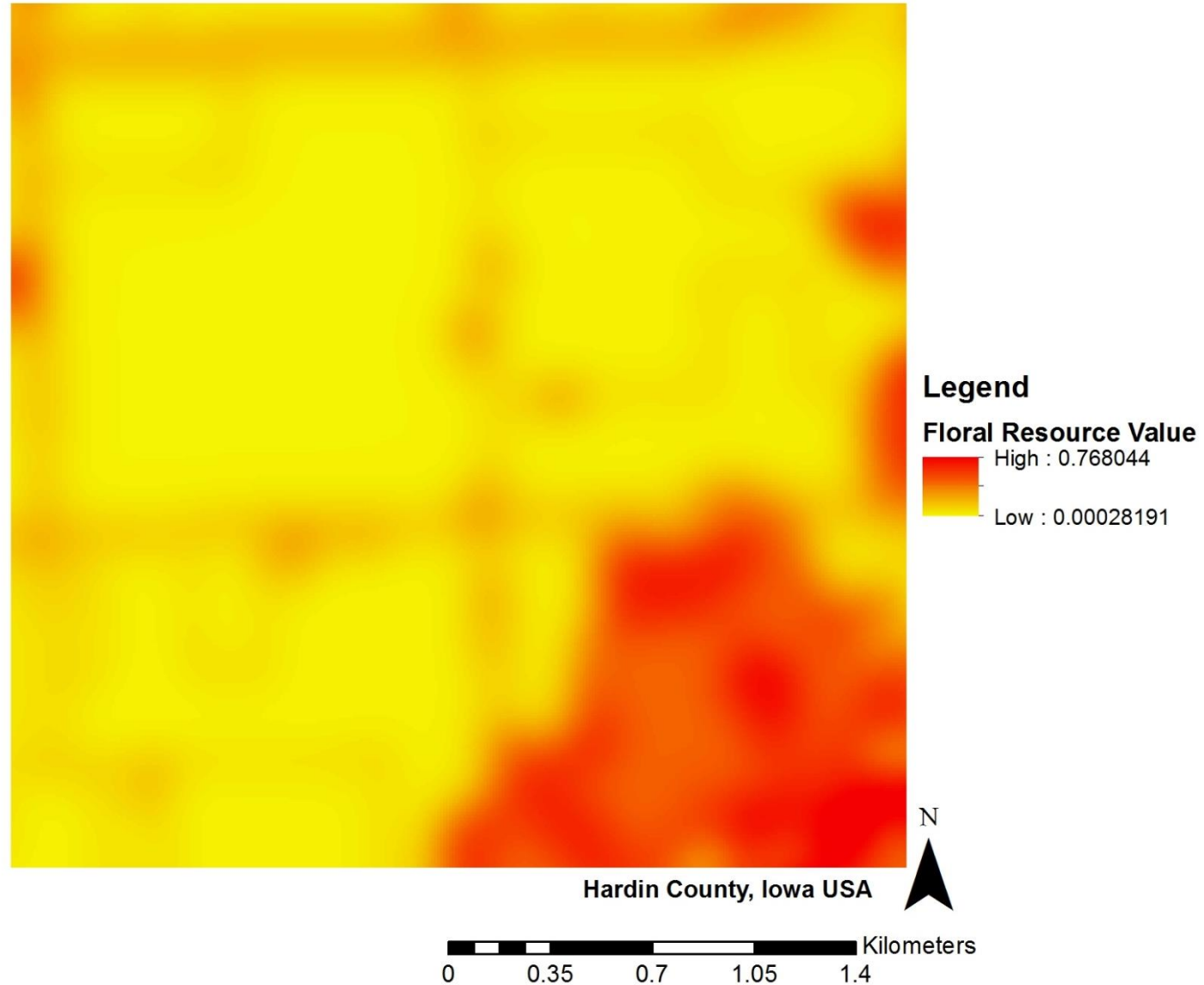
Legend

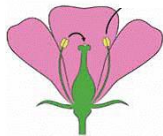
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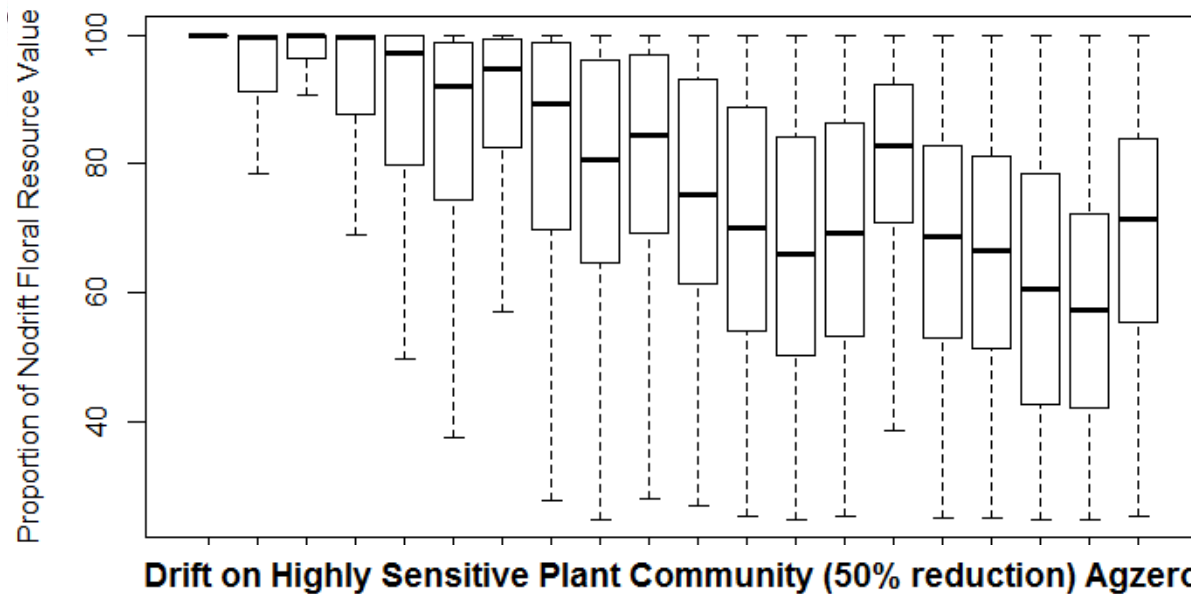


Pollinator Accessible Spring Floral Resources

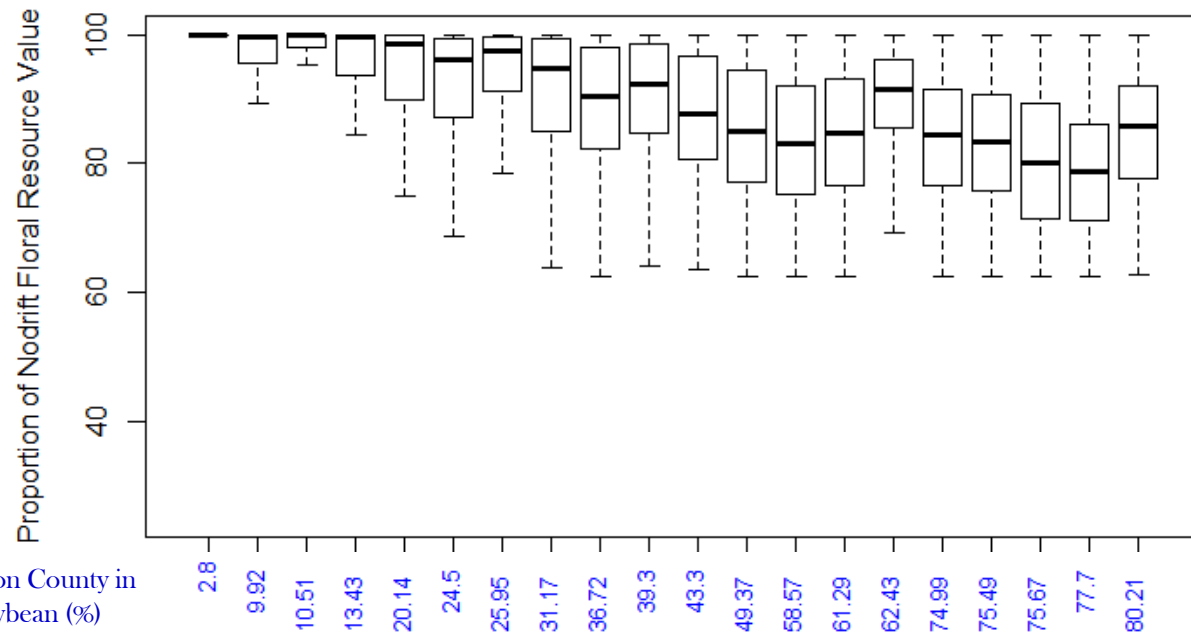


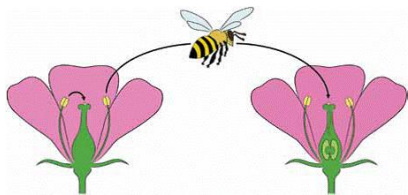


Label Rate Application Agzero

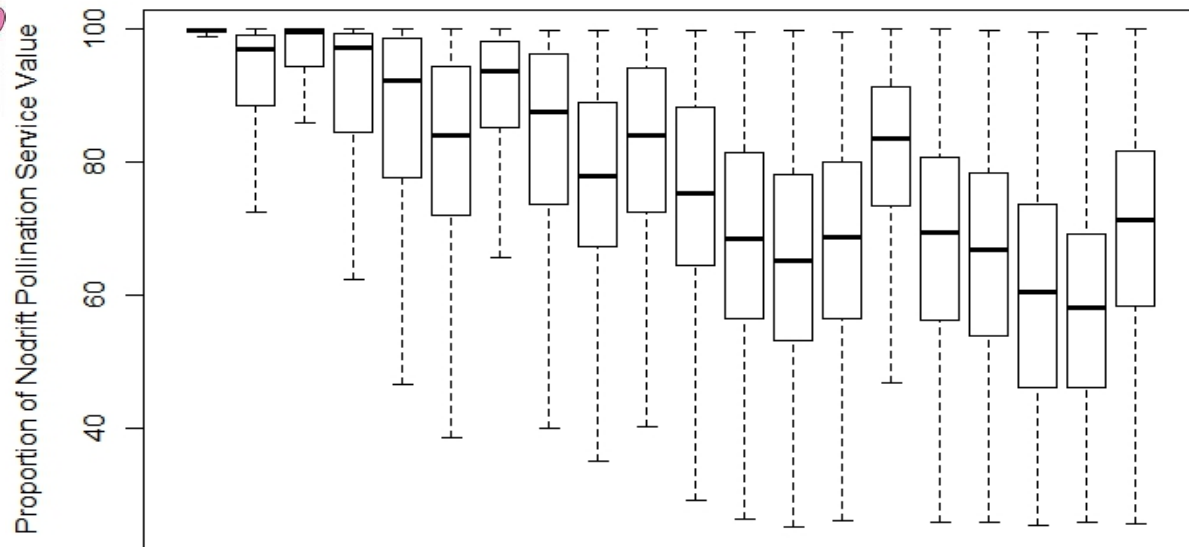


Proportion County in
Corn/Soybean (%)

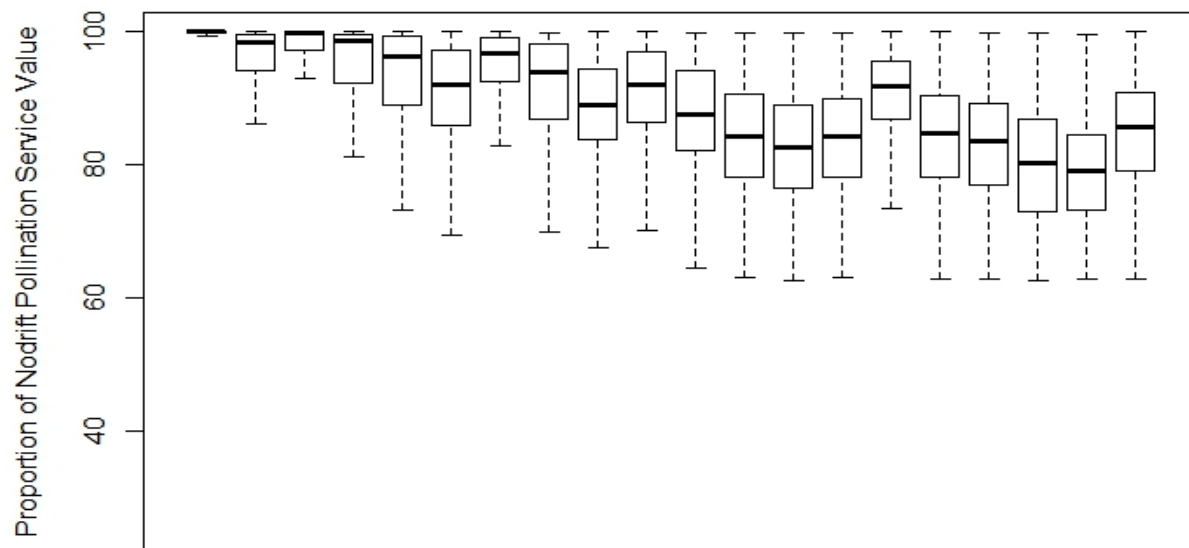




Label Rate Application Agzero



Drift on Highly Sensitive Plant Community (50% reduction) Agzero



Proportion County in Corn/Soybean (%)

2.8
9.92
10.51
13.43
20.14
24.5
25.95
31.17
36.72
39.3
43.3
49.37
58.57
61.29
62.43
74.99
75.49
75.67
77.7
80.21

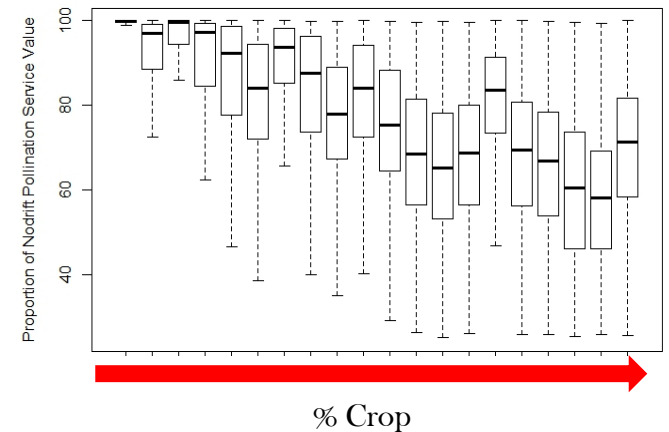
Conclusions

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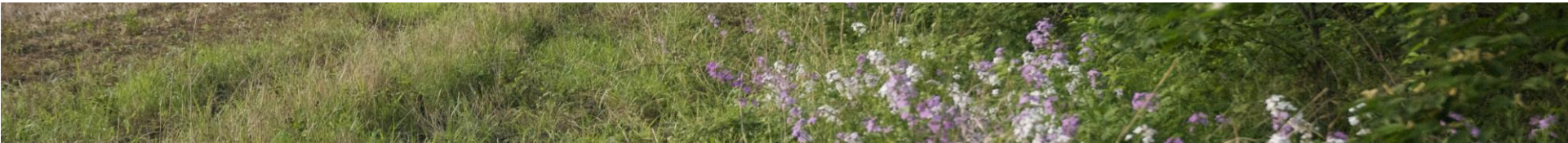
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- The impact of the scenario evaluated was highly dependent on landscape context with the largest impacts observed in areas with the largest proportion corn and soybean.
- At drift-level doses the *floral* and *pollinator resource* provisioning capacity of the landscape was reduced by approximately 20% in counties with greater than 50% corn and soybean and exceeded 40% when those same edges were exposed to label doses.



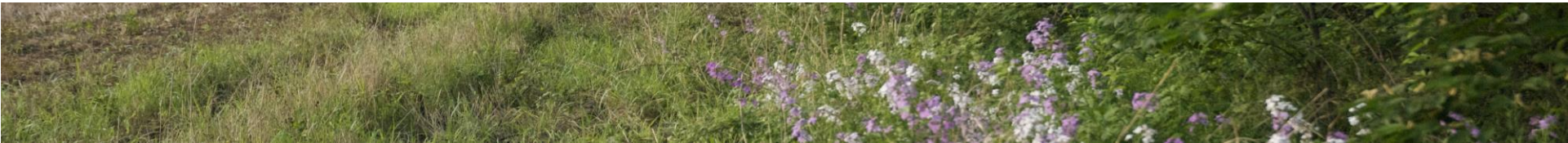
Applications and Future Work

- We need a more thorough understanding of the importance of model assumptions.
 - Field scale drift patterns
 - Extent of practice adoption



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 - Extent of practice adoption
- Several parameters which strongly influenced model scenarios are not well understood.
 - Range of plant and pollinator responses to herbicide drift
 - Baseline resource estimates and pollinator use of habitats present in agricultural landscapes, including arable land.



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 - Field scale drift patterns
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- Several parameters which strongly influenced model scenarios are not well understood.
 - Range of plant and pollinator responses to herbicide drift
 - Baseline resource estimates and pollinator use of habitats present in agricultural landscapes, including arable land.
- A strong consideration for landscape context should be included in herbicide drift risk assessment and deregulation policy.



Our Team:



Franklin Egan (left), USDA Pasture Lab and **John Tooker**, Entomology Department



Felix Bianchi **Wopke van der Werf**
Farming Systems Ecology Group, Wageningen University



Melanie Kammerer-Allen, Weed Ecology Lab

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Laura Russo, David Kersey, Dr. Kat Shea

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