Supporting beneficial insects on farms and in the landscape

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Photo Anne Readel

1 What are beneficial insects?

and why should we care?

2 How can we better conserve them in agricultural landscapes?

Pollinators

Predators

Decomposers

Photos (L-R): Anne Readel, Curt Stepnitz, Katja Schulz, Claudio Gratton, Getty Images, iStockphoto

Pollinators

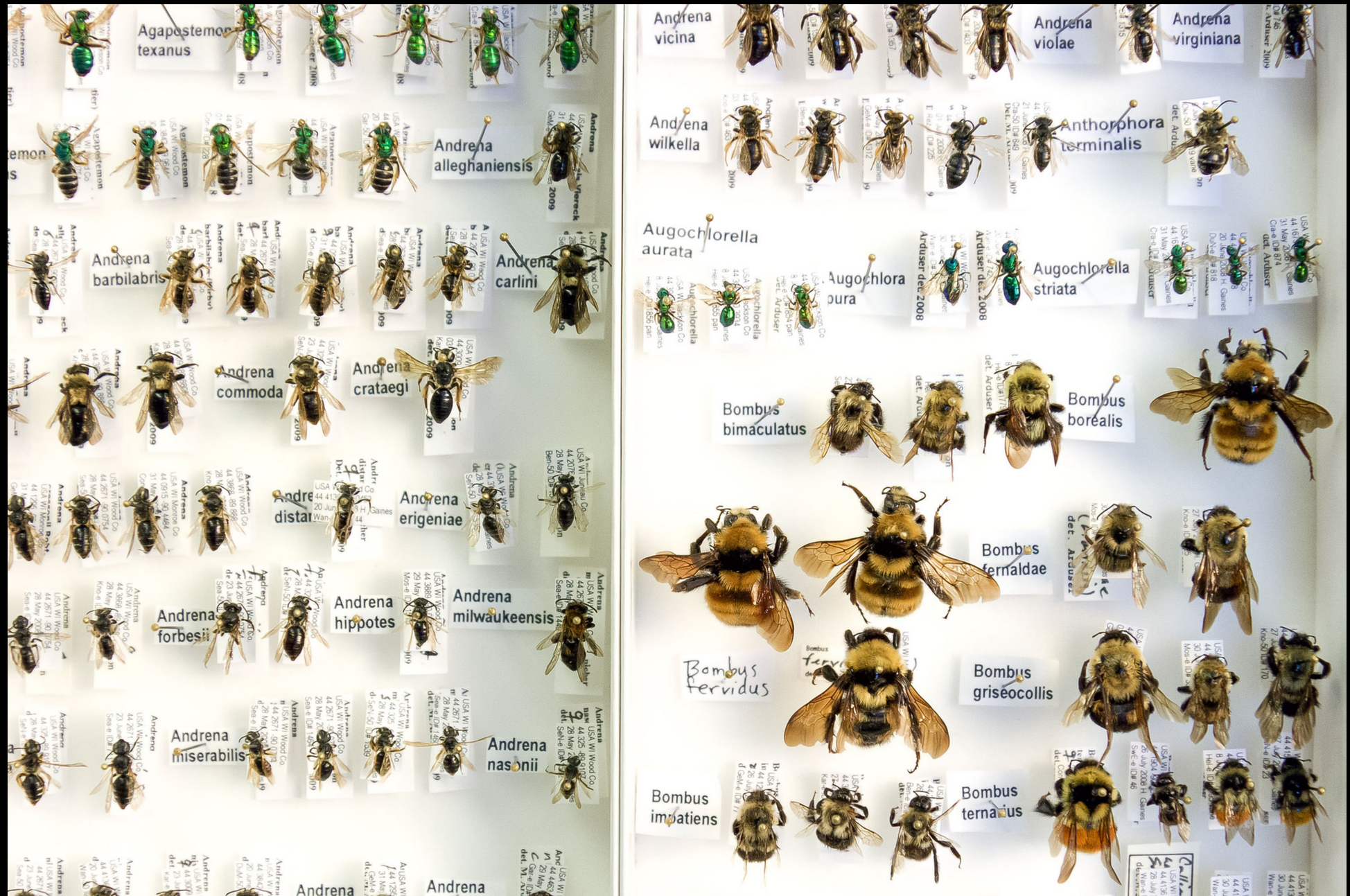
Predators

Decomposers


Honey bees are managed bees, native to Europe
Photo by Maddy Verbuchen

Wisconsin has over 400 species of native, wild bees
Awesome pollinators!

Native bees as alternative (and free) pollinators



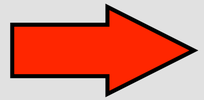
Pollination

Photo Jeremy Hemberger

35% of our crop species and 85% of all flowering plants depend on pollinators

Table 2 – Economic impact of insect pollination of the world agricultural production used directly for human food and listed by the main categories ranked by their rate of vulnerability to pollinator loss; the economic value of insect pollination was calculated following (1)

Crop category	Average value of a production unit	Total production economic value (EV)	Insect pollination economic value (IPEV)	Rate of vulnerability (IPEV/EV)
	€ per metric ton	10^9€	10^9€	%
Stimulant crops	1225	19	7.0	39.0
Nuts	1269	13	4.2	31.0
Fruits	452	219	50.6	23.1
Edible oil crops	385	240	39.0	16.3
Vegetables	468	418	50.9	12.2
Pulse	515	24	1.0	4.3
Spices	1003	7	0.2	2.7
Cereals	139	312	0.0	0.0
Sugar crops	177	268	0.0	0.0
Roots and tubers	137	98	0.0	0.0
All categories pooled together		1618	152.9	9.5



~ $270 billion worldwide value

Gallai et al. 2009 Ecological Economics

Wisconsin

~ $180 million sales

lose ~90% without insect pollination

Pollinators

Predators

Decomposers

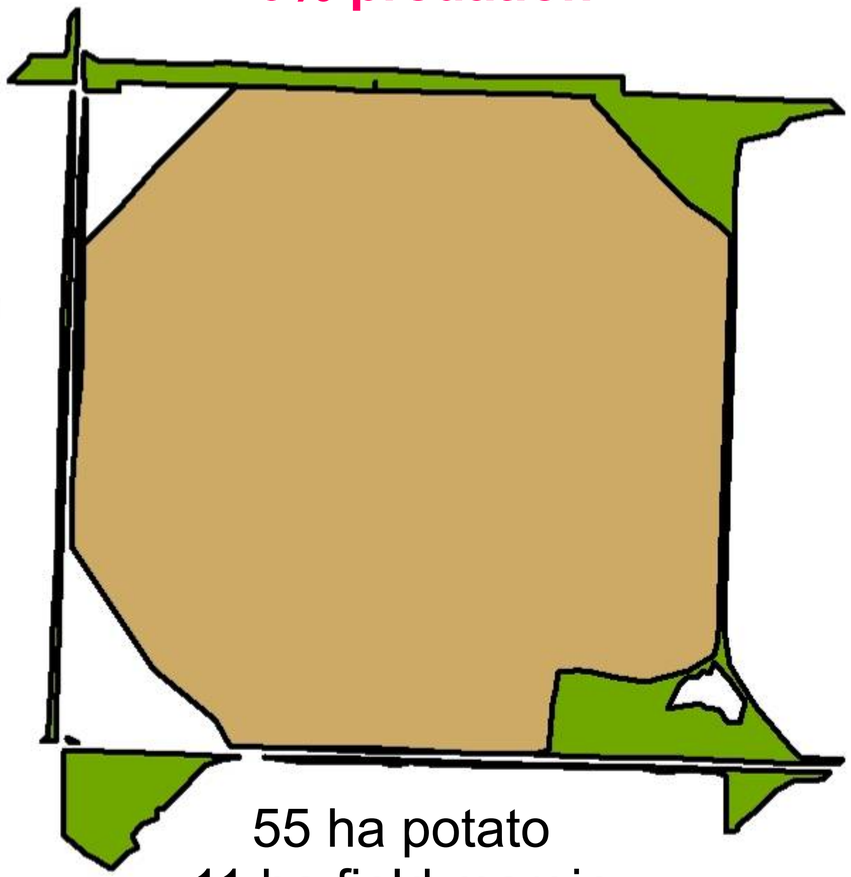
Photo iStockphoto

Pest control

Greater predation on Colorado Potato Beetle eggs when more off-crop field margins relative to crop area

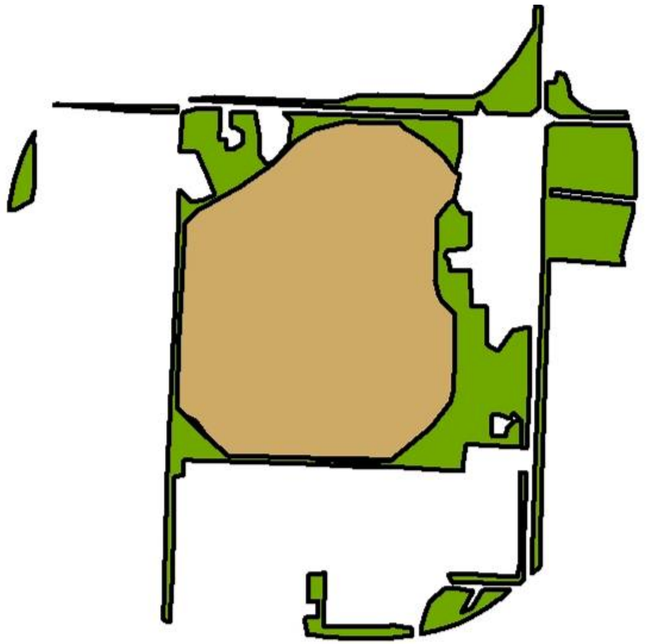
0% predation

200 m

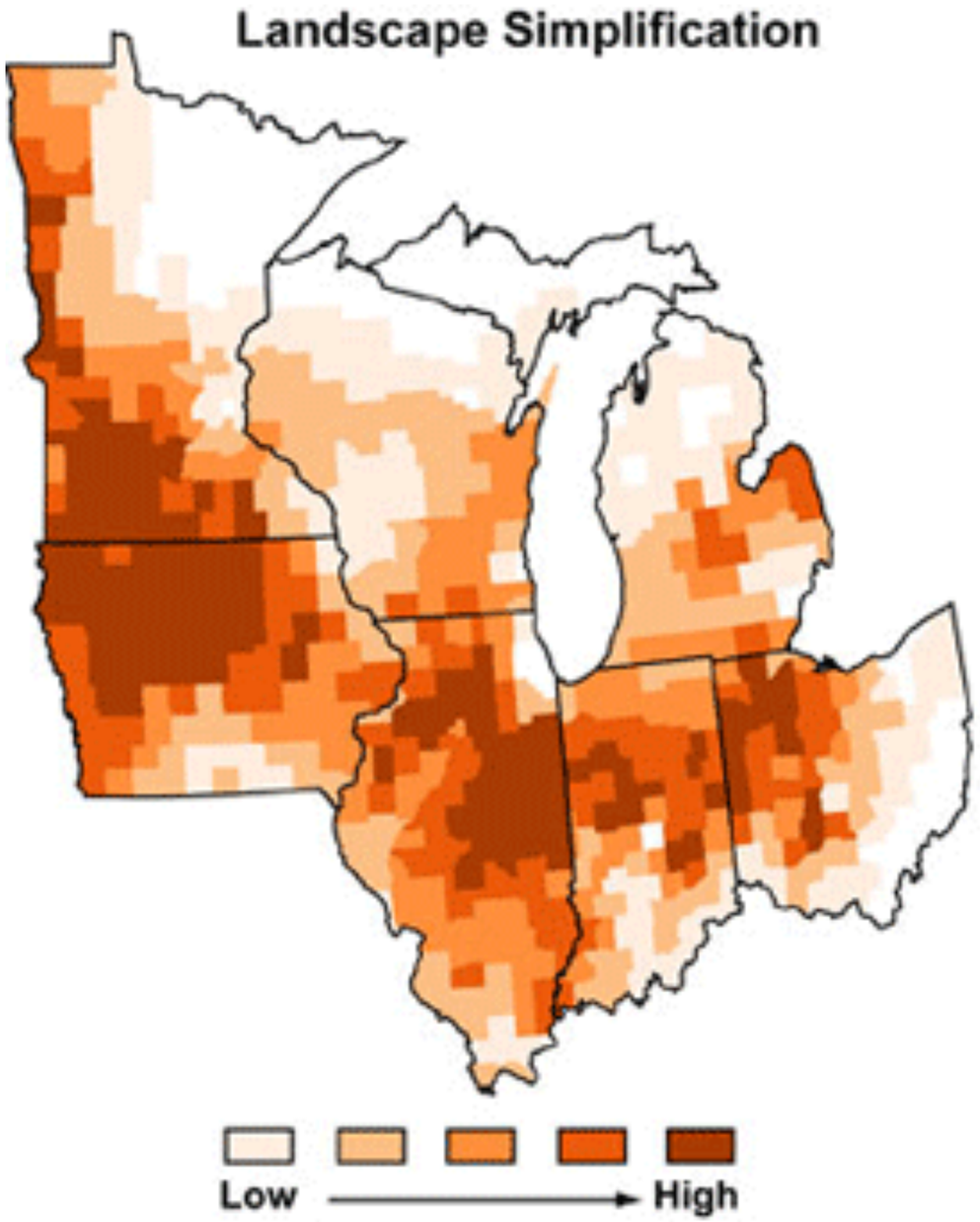


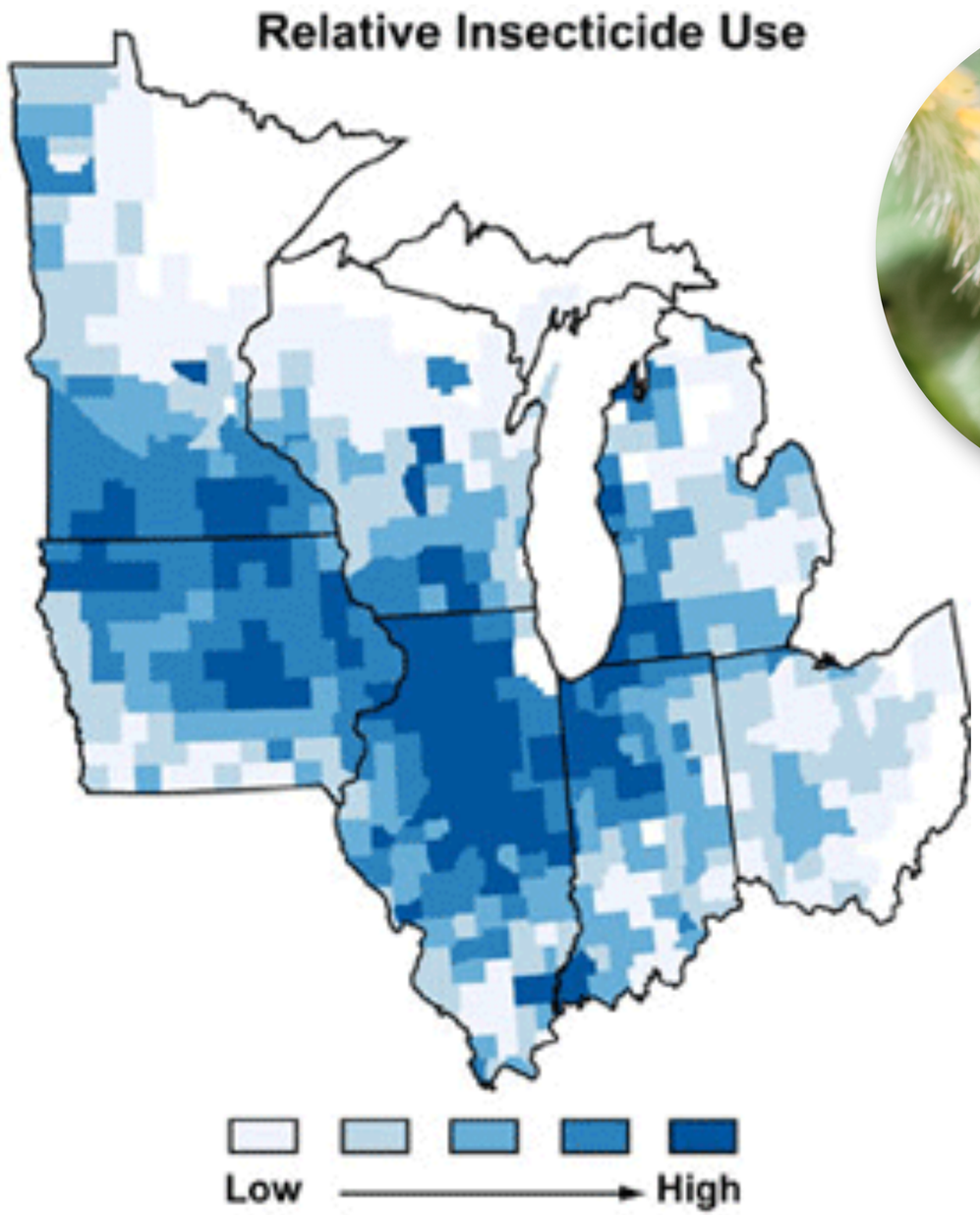
55 ha potato
11 ha field margin

19-30% predation



10 ha potato
12 ha field margin





Meehan et al. 2011 PNAS

Pollinators

Predators

Decomposers

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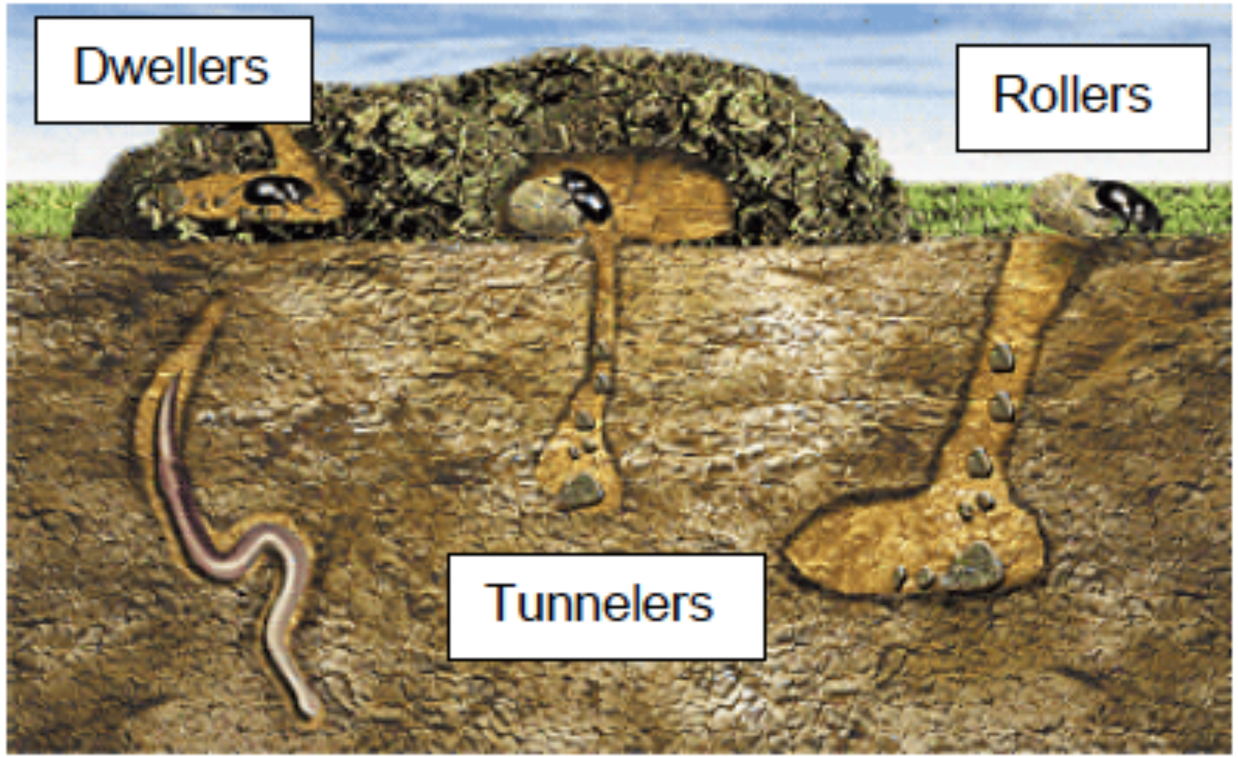
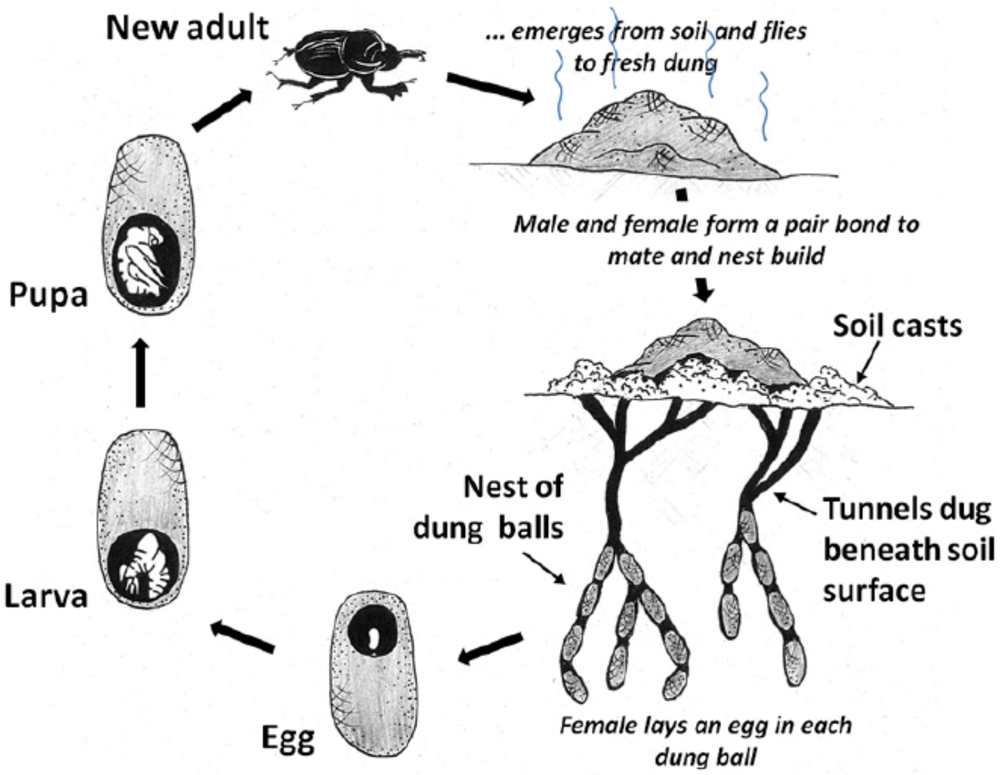
Ken Wise | NYSIPM klw24@cornell.edu

Dung burial



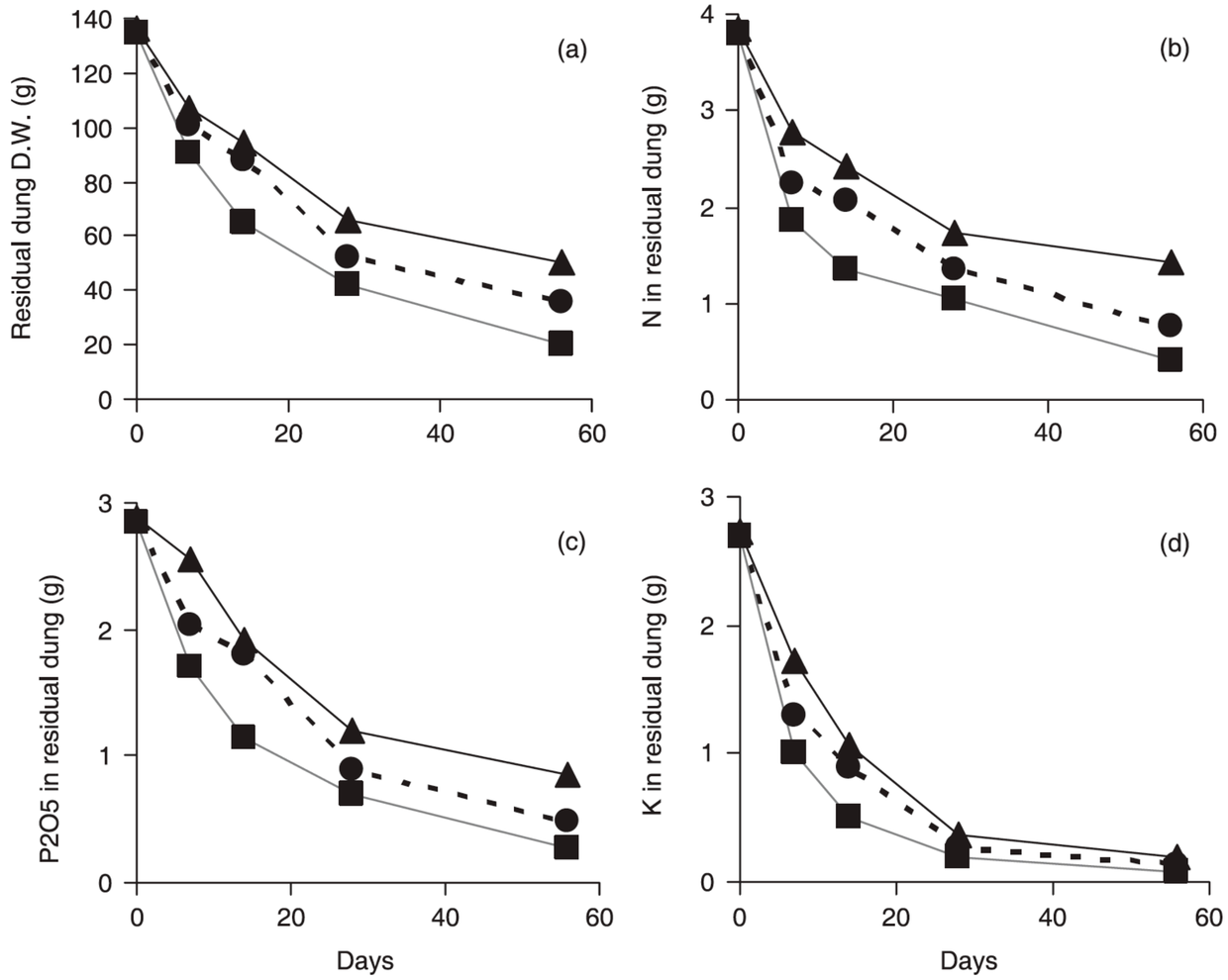


Disappearance rate depends on lots of things

~2-3 months, most within 1 growing season

https://youtu.be/8_S_wCsorcM

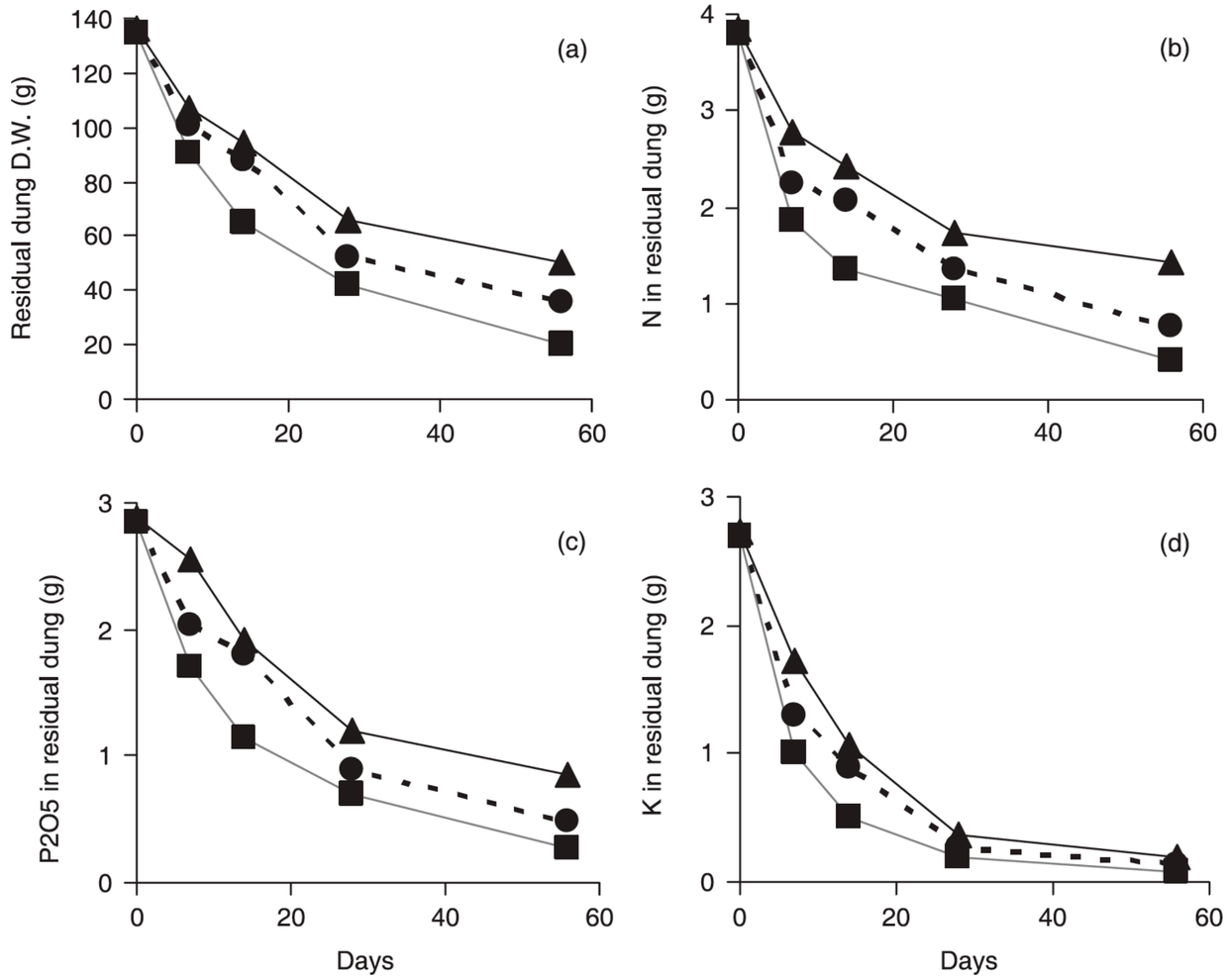
Dung burial

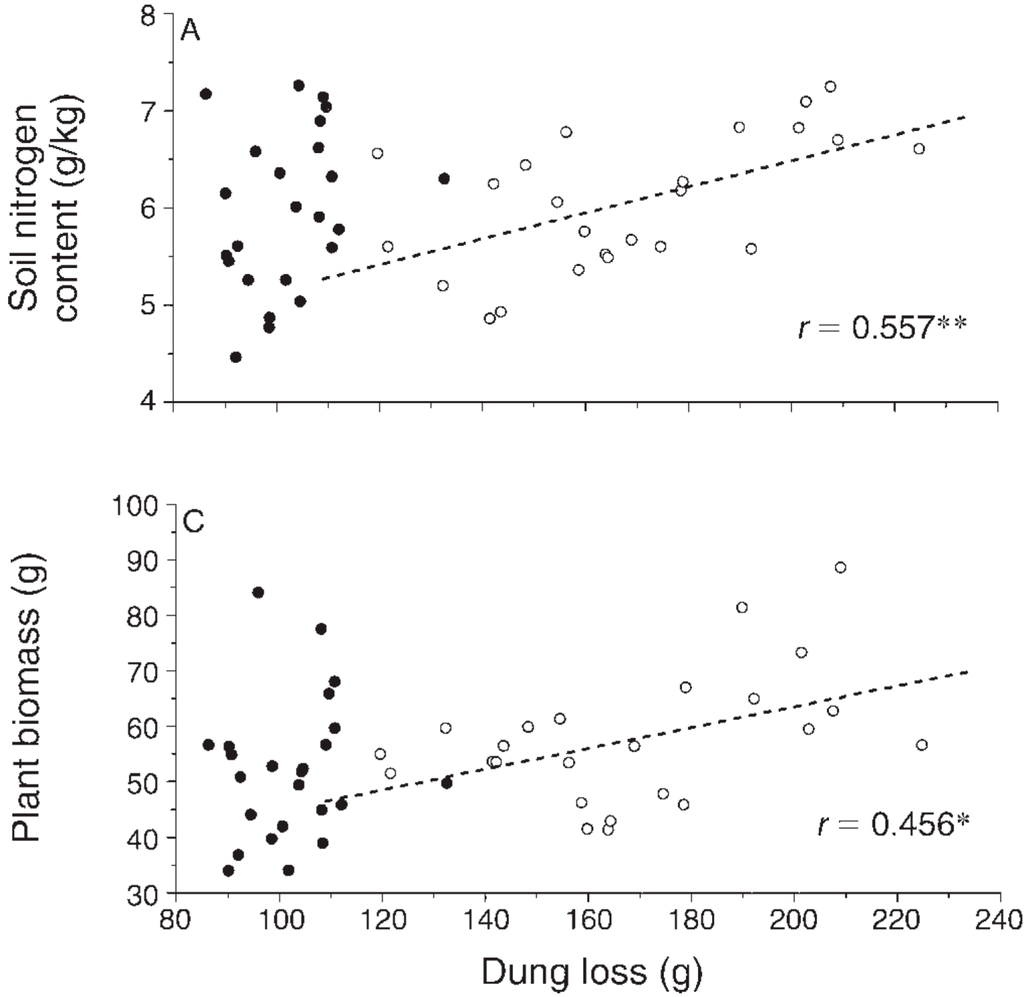


Yamada et al. 2007 Grassland Science

+30% more dung lost in 1 month when there are beetles

Dung burial





Yamada et al. 2007 Grassland Science

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Wu et al. 2010 Ecol. Monographs

Dung burial

Control of Face and Horn flies	Control of gastrointestinal parasites	Reduced pasture fouling	Increase nutrient cycling
$6	$28	$8	$12

$54 per animal / yr

UK study, dung beetles vs. no beetles

Benyon et al. 2005 Ecol. Entom.

Common Wisconsin Dung beetles

	***Aphodius badipes*** (‘big black beetle”)—an all-black scarab beetle greater than 1 cm long with fossorial legs
	***Aphodius fimetarius*** (“red backs”)—a mostly black, non-native scarab beetle of European origin with red elytra; less than 1 cm long, with fossorial legs
	***Aphodius granarius*** (“small black beetle”)—an all-black, non-native scarab beetle of European origin; less than 5 mm long, with fossorial legs
	**Aphodius rubripinnis** (“brown backs”)—a scarab beetle chararcterized by reddish-brown elytra, less than 1 cm long, with fossorial legs
	***Onthophagous hecate***—an all-black scarab beetle less than 1 cm long, with fossorial legs, exhibiting sexual polymorphism
	***Onthophagous nuchicornis***—Non-native beetle of European origin characterized by yellow and black elytra, 5 - 8 mm long, with fossorial legs, exhibiting sexual polymorphism
	***Sphaeridium scarabaeoides*** (“half brown backs”)—beetle representing the family Hydrophilidae, characterized by brown, red and black elytra, and legs with spines; 5 - 7 mm long
	***Xestipyge conjunctum*** (“headless beetle”)—beetle representing the family Histeridae, an all-black, flat, glossy beetle less than 1 cm long, with a strongly retracted head and fossorial legs

Daeda, Scheffer and Young 2012 UW Extension

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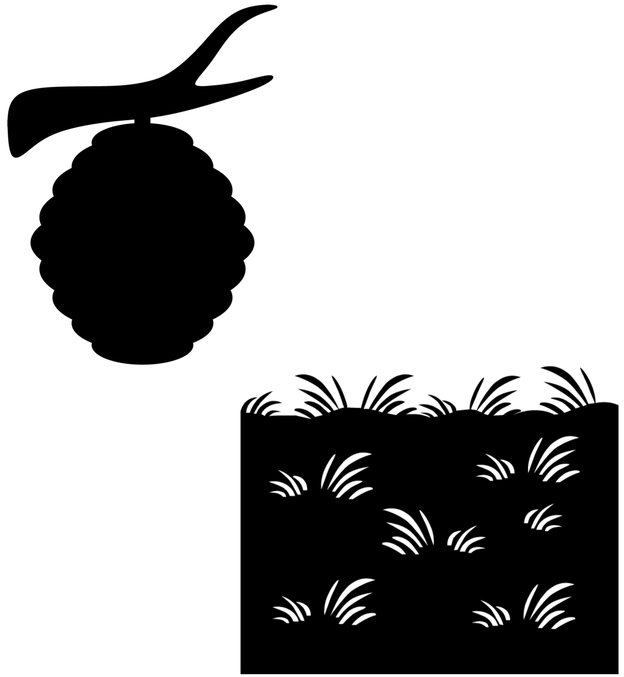
2 How can we better conserve them in agricultural landscapes?

How to conserve beneficial insects?

FOOD



SHELTER

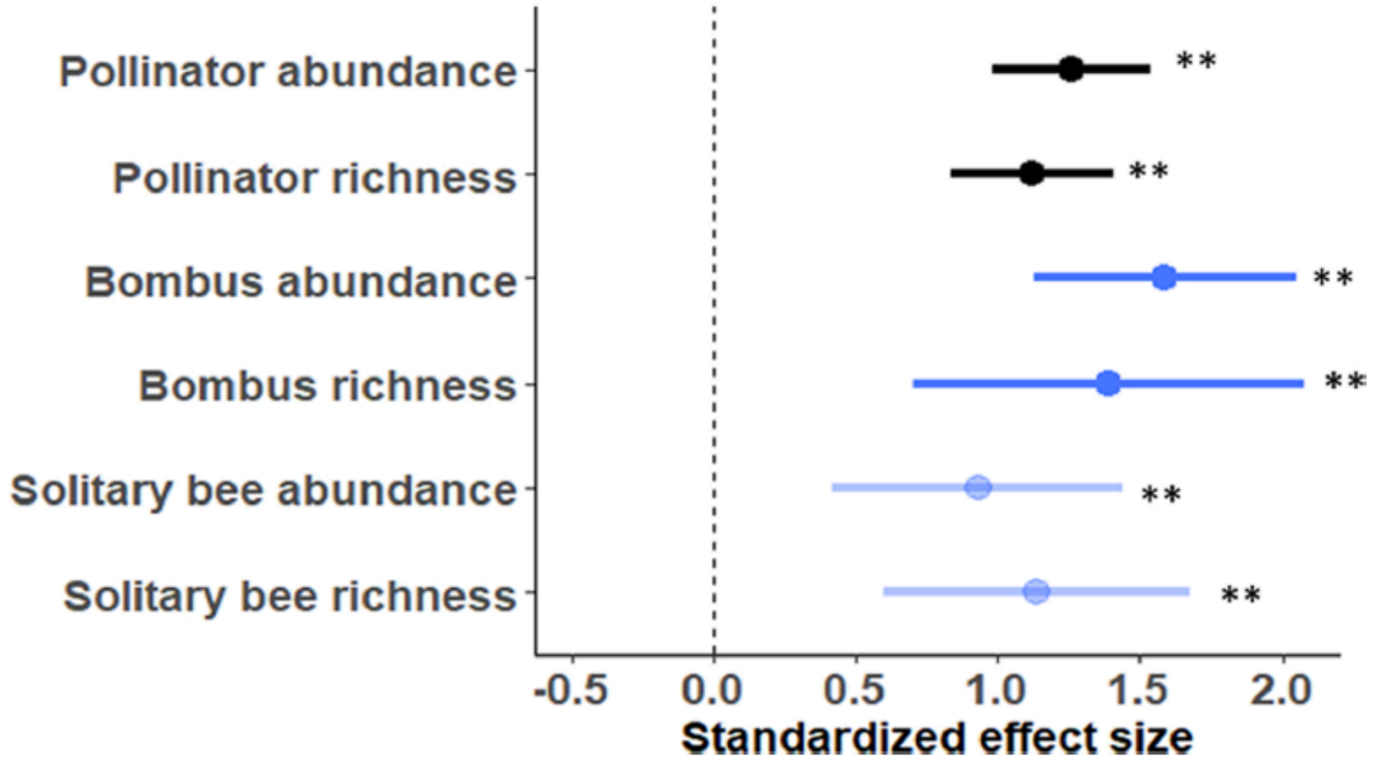
NON-TOXIC HABITAT

FOOD

Pollen (Nectar)

Different types of flowers have different nutrient composition

When you have flowers, you have more bees and they are more diverse



A hedgerow of native flowering shrubs flanked by native bunch grasses offers many resources to pollinators. The fallen grass can become a haven for bumble bee nests and the shrubs provide pollen and nectar. (Photograph by Jessa Kay Cruz, The Xerces Society.)

Wildflower buffer supports pollinators and beneficial insects adjacent to organic crops. (Photograph by Jennifer Hopwood, The Xerces Society.)

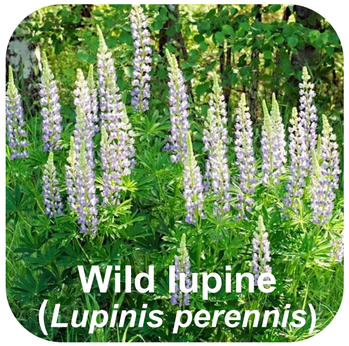
Lowe and Gratton 2021 Agriculture, Ecosystems and Environment

FOOD

Choose native species that are co-evolved with our wild native pollinators!

Early


Tickseed
(*Coreopsis*)


Wild lupine
(*Lupinis perennis*)

Mid


Coneflower
(*Echinacea*)

Late


Goldenrod
(*Solidago*)


New England Aster
(*Symphyotrichum*)


Smooth penstemon
(*Penstemon digitalis*)


Bergamot
(*Monarda*)

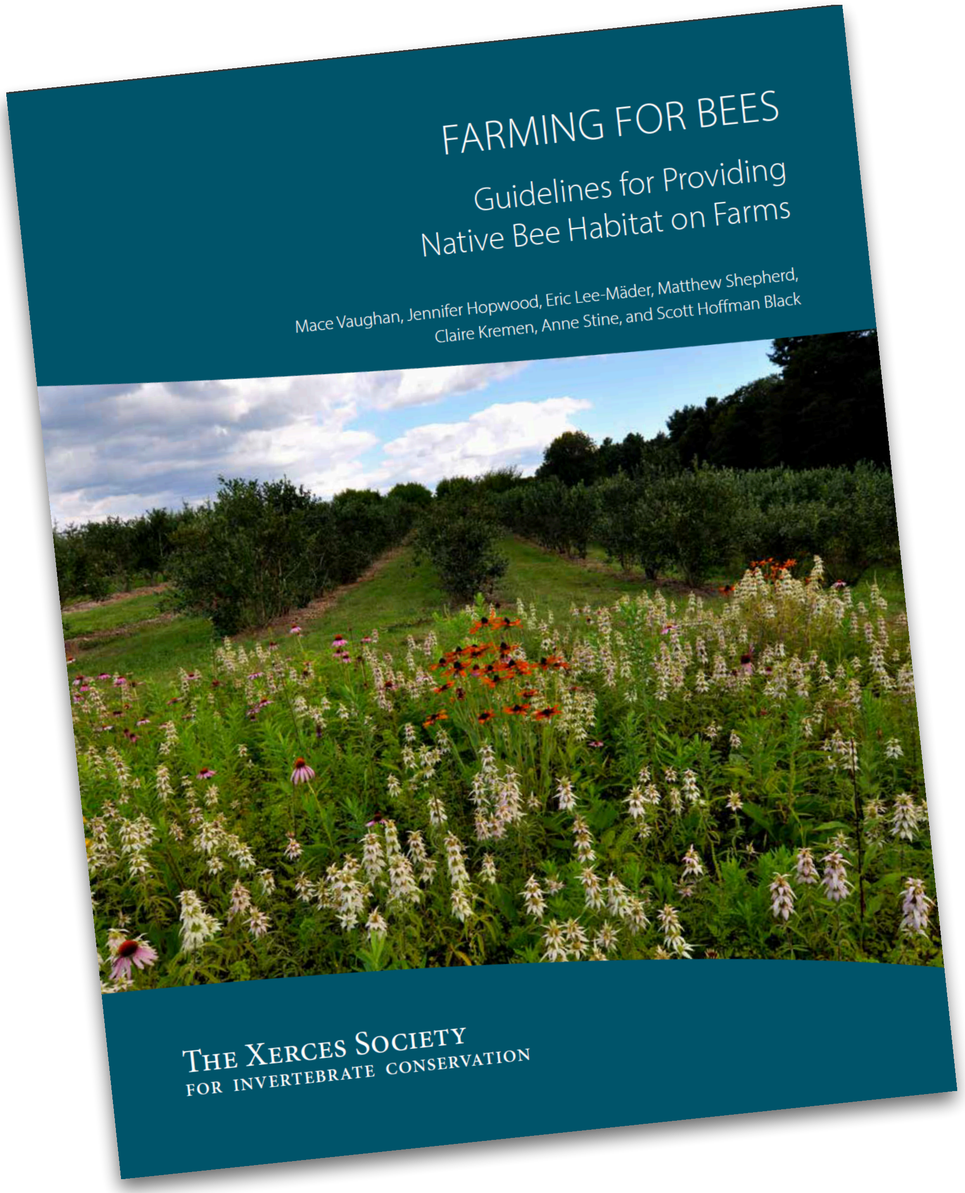

Cup Plant
(*Silphium*)


Field thistle
(*Cirsium discolor*)

FOOD

Prey
(protein)

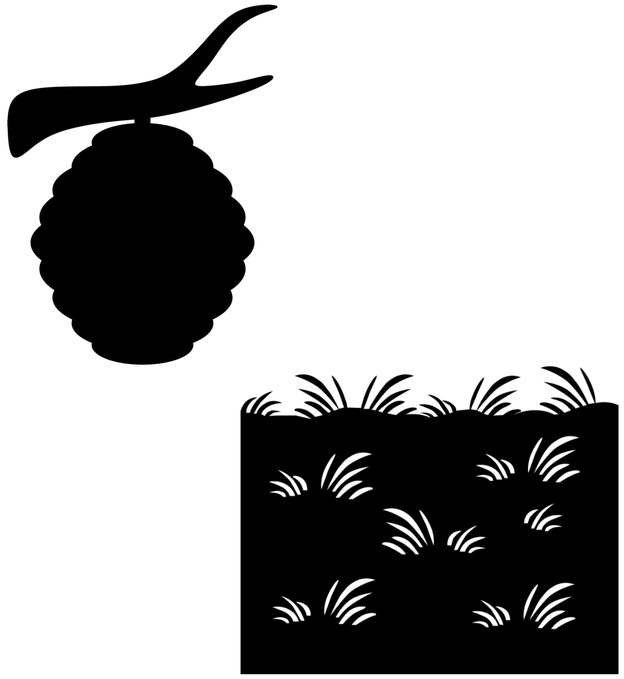
Nectar
(carbohydrates)



www.xerces.org

How to conserve beneficial insects?

FOOD



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NON-TOXIC HABITAT

Ground nesting (~70% of bees)

Xerces Society

P. Westrich

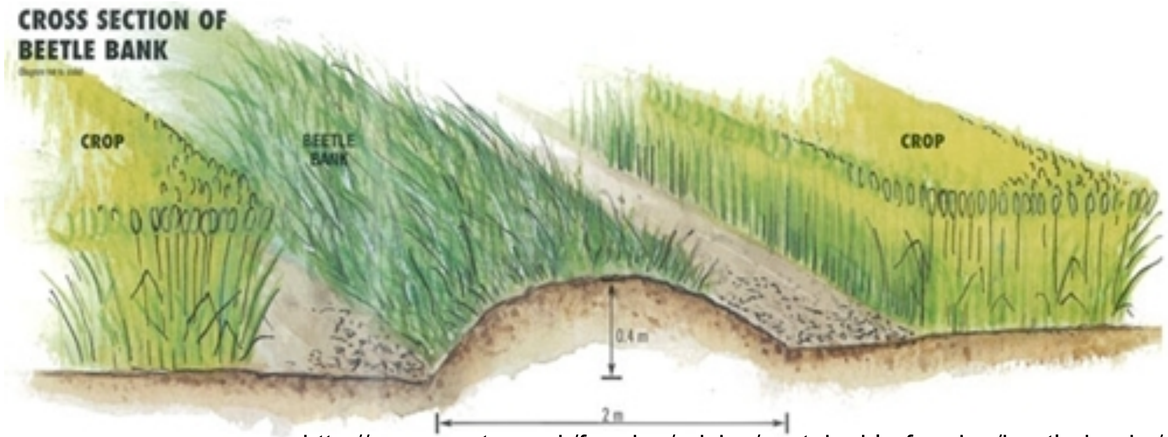
K. Ullmann

Dennis Briggs

Habitat loss is one of main factors responsible for wild bee declines

Photo Clay Bolt

Reduce disturbances and / or create permanent refuges



http://www.gwct.org.uk/farming/advice/sustainable-farming/beetle-banks/

“Beetle banks” and Conservation headlands (Europe)

Agriculture with more perennial crops and habitats

Annual

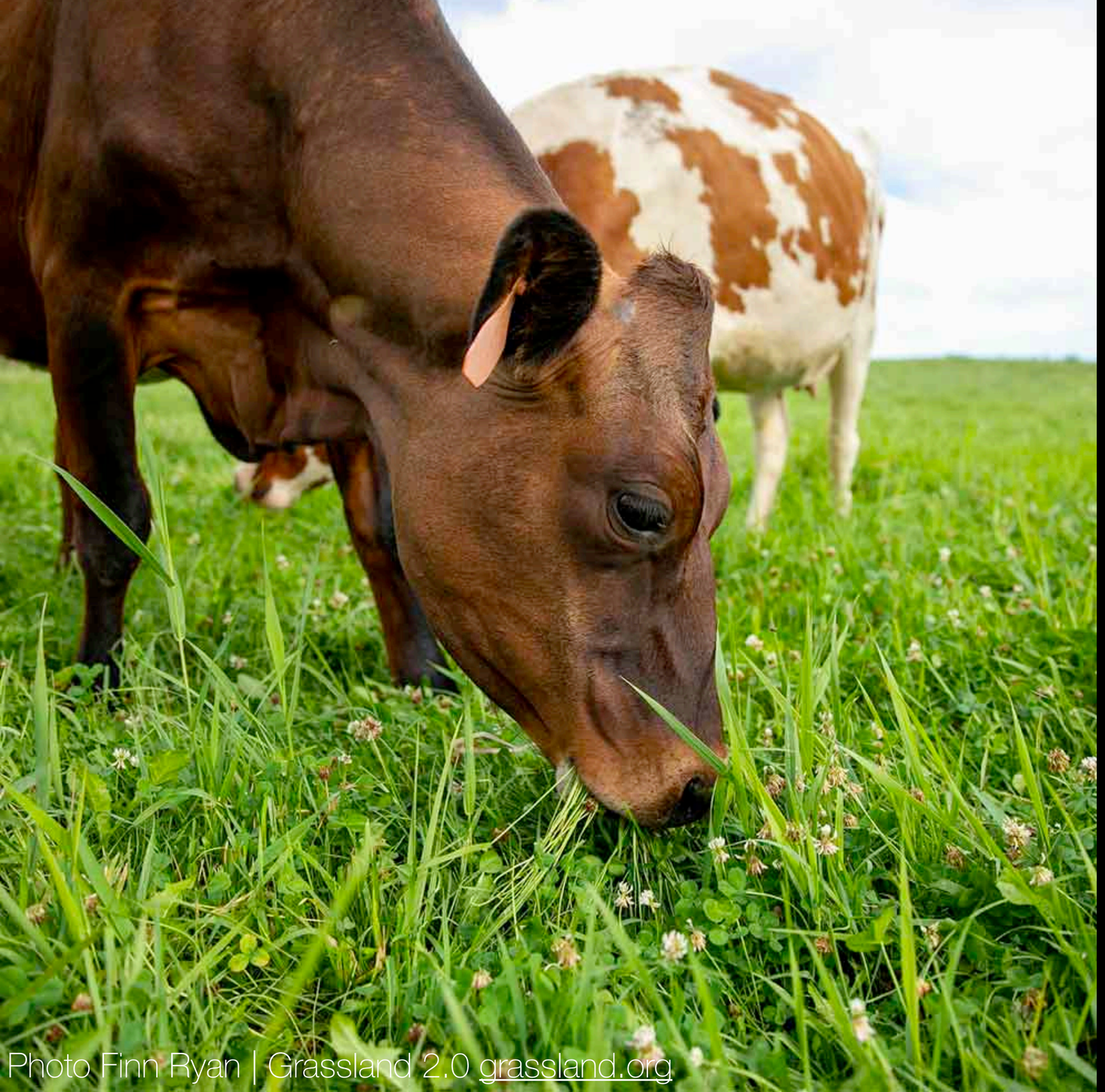
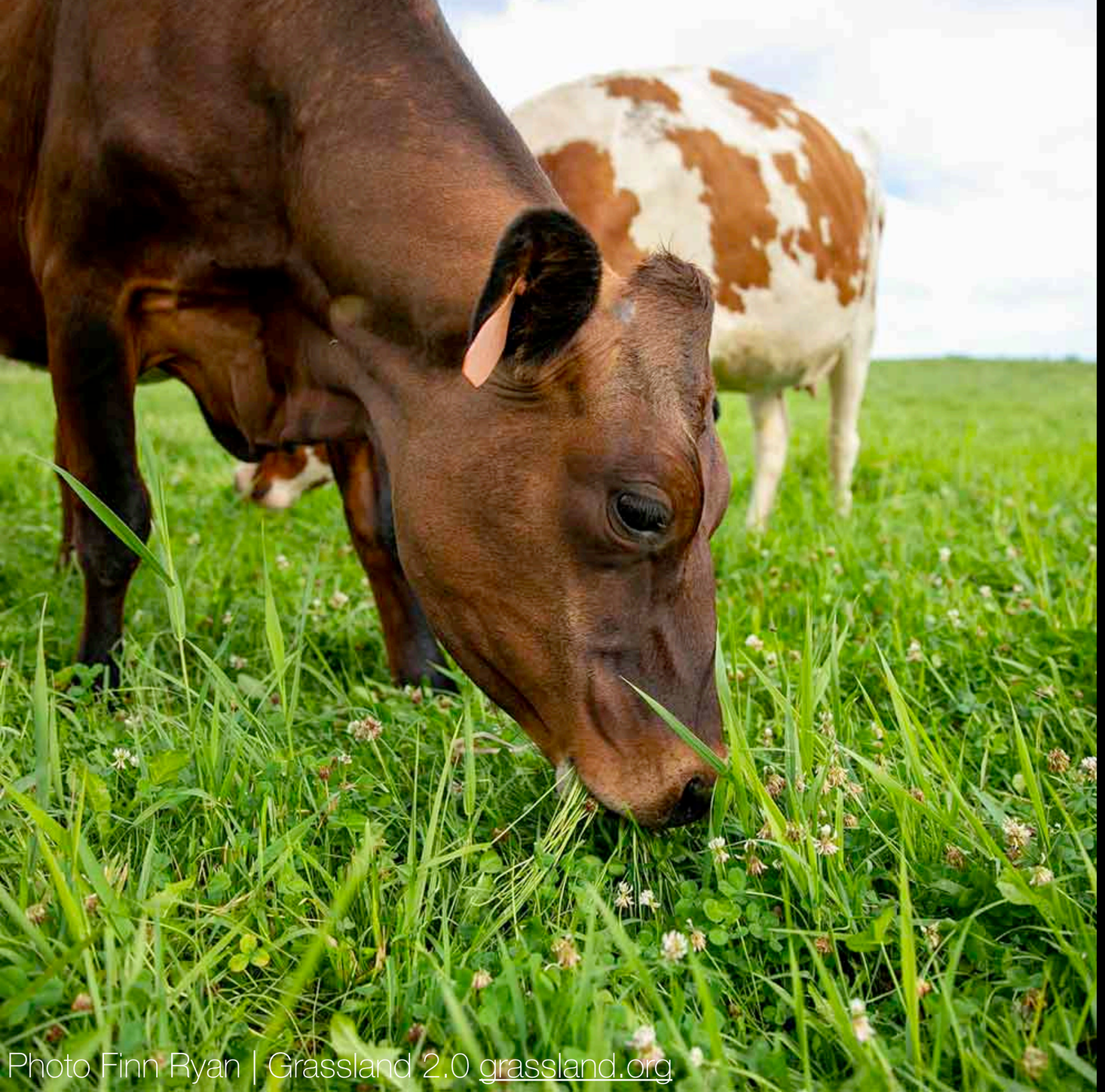


Photo Finn Ryan | Grassland 2.0 grassland.org

Photo Skye Harnsberger



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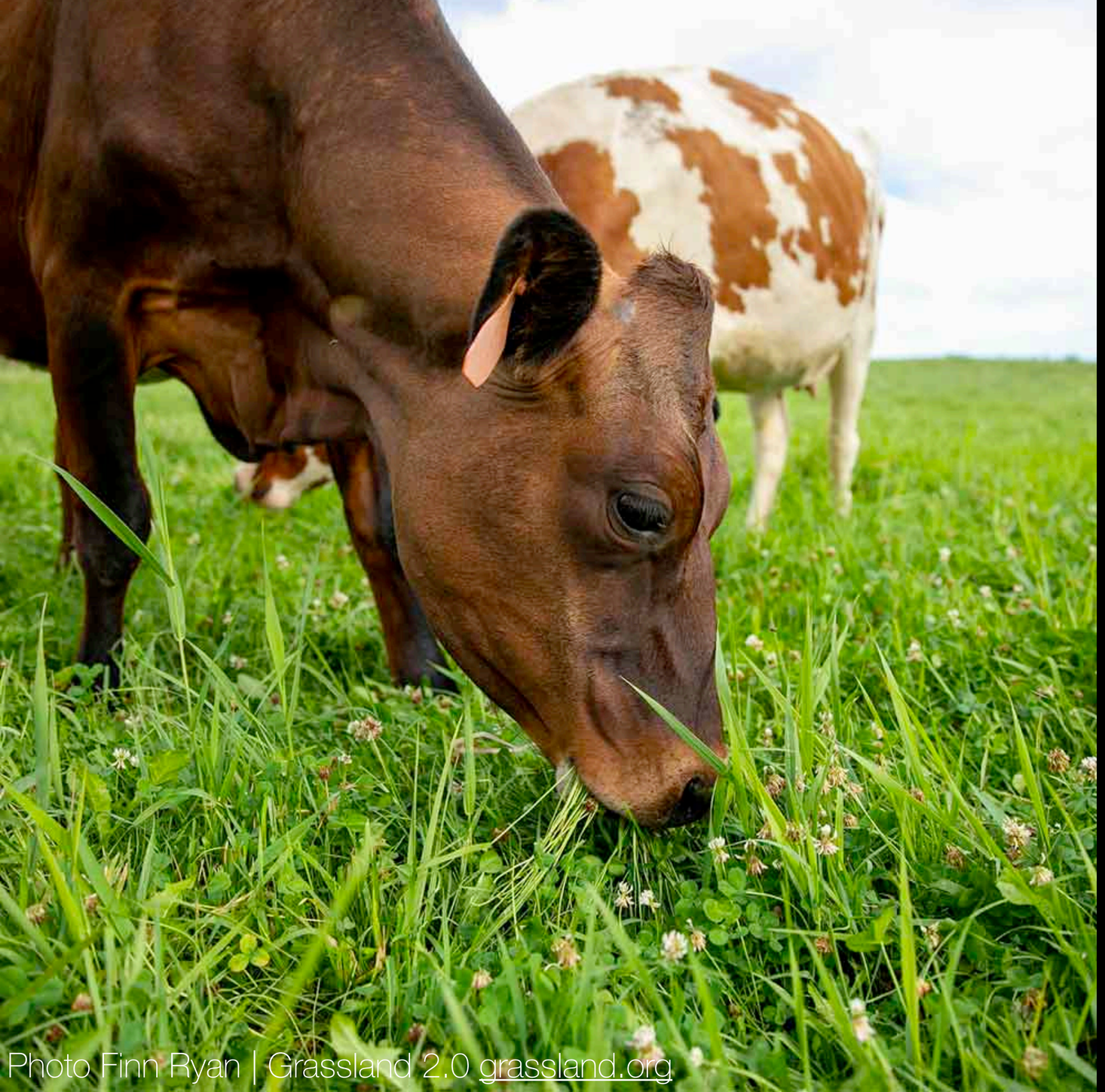

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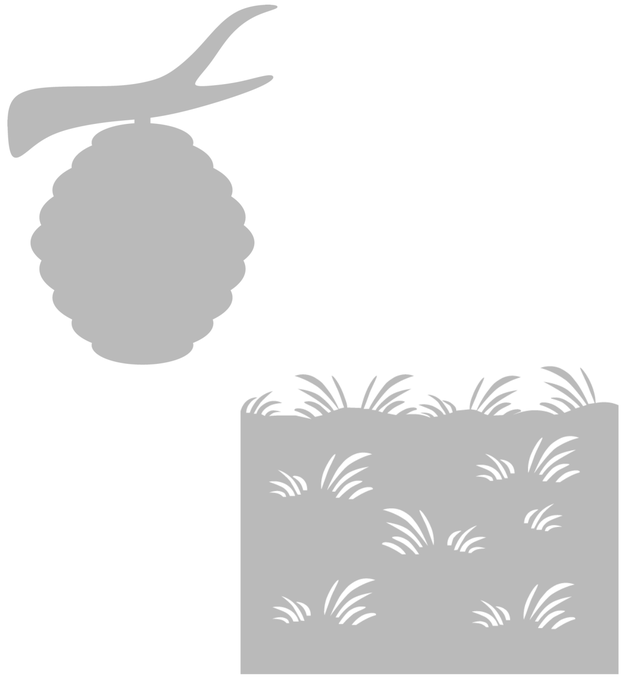
Photo Skye Harnsberger

What do beneficials need to thrive?

FOOD



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NON-TOXIC HABITAT

NON-TOXIC HABITAT

Purdue Extension Entomology

Neonicotenoids

Thiamethoxam

Imidachloprid

Clothianidin

- Direct mortality at high concentrations
- Negative effects on growth, development, navigation, and other behavior even at low concentrations
- “Safe” thresholds unknown for most species

Practice IPM

IPM reduces insecticide applications by 95% while maintaining or enhancing crop yields through wild pollinator conservation

Jacob R. Pecenka[a,1], Laura L. Ingwell[a], Rick E. Foster[a], Christian H. Krupke[a], and Ian Kaplan[a]

[a]Department of Entomology, Purdue University, West Lafayette, IN 47907

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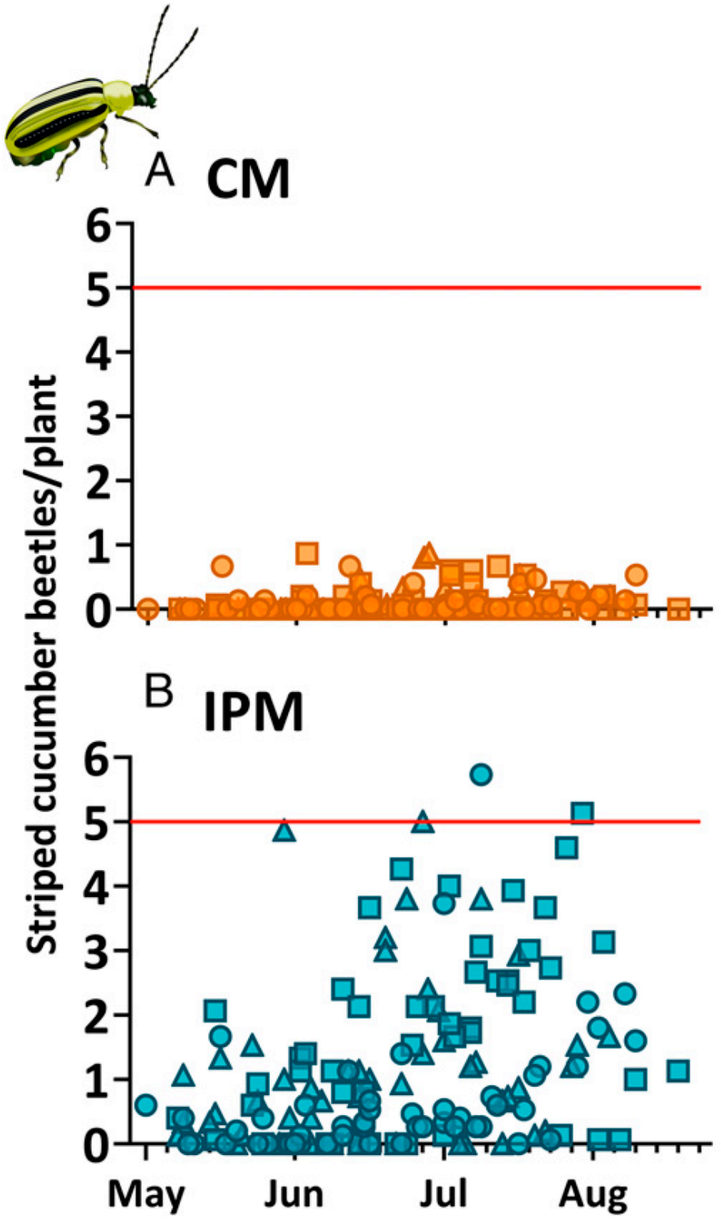

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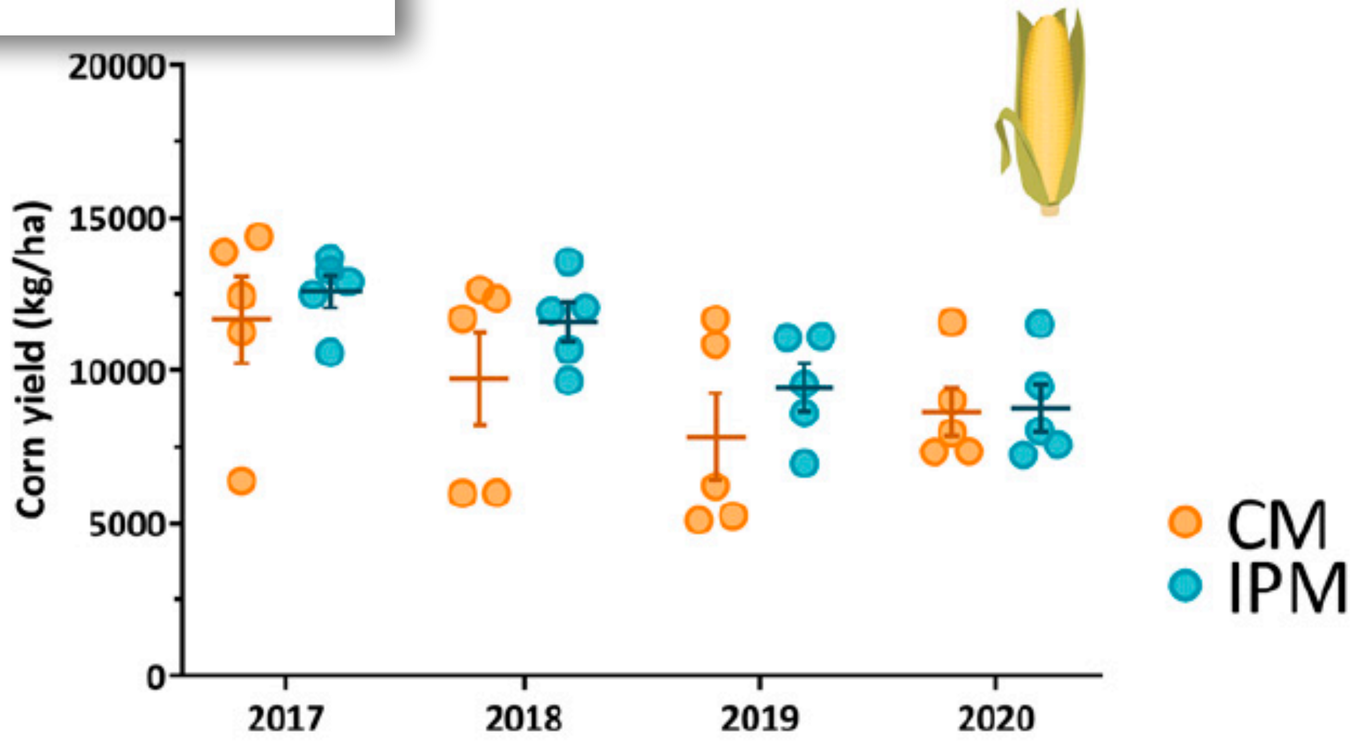
No difference in corn yield



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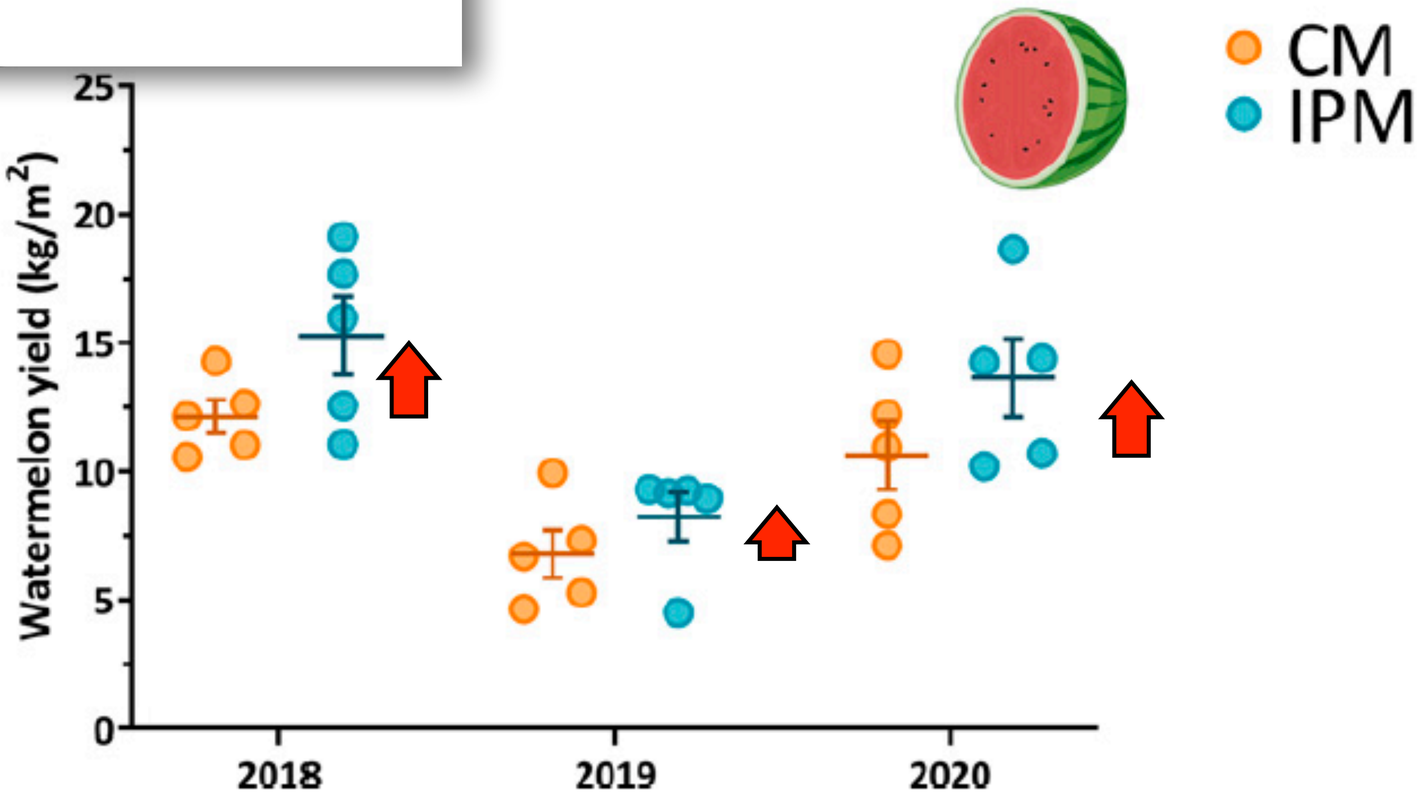
+25% increase in watermelon yield



NON-TOXIC HABITAT

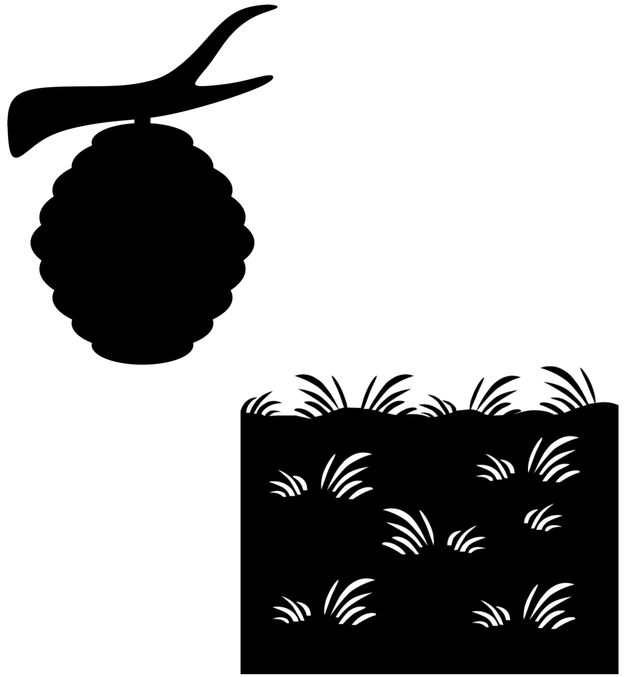
Use of antihelminthics (avermectins) in cattle reduces dung beetles by 80% up to 3 months after treatment

Decline in dung pat decomposition

Nieman et al 2018 PLOS One

How to conserve beneficial insects?

FOOD



SHELTER

NON-TOXIC HABITAT

Questions?

GRATTON LAB

LANDSCAPE ECOLOGY OF INSECTS

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Photo Claudio Gratton

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